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City, County and State

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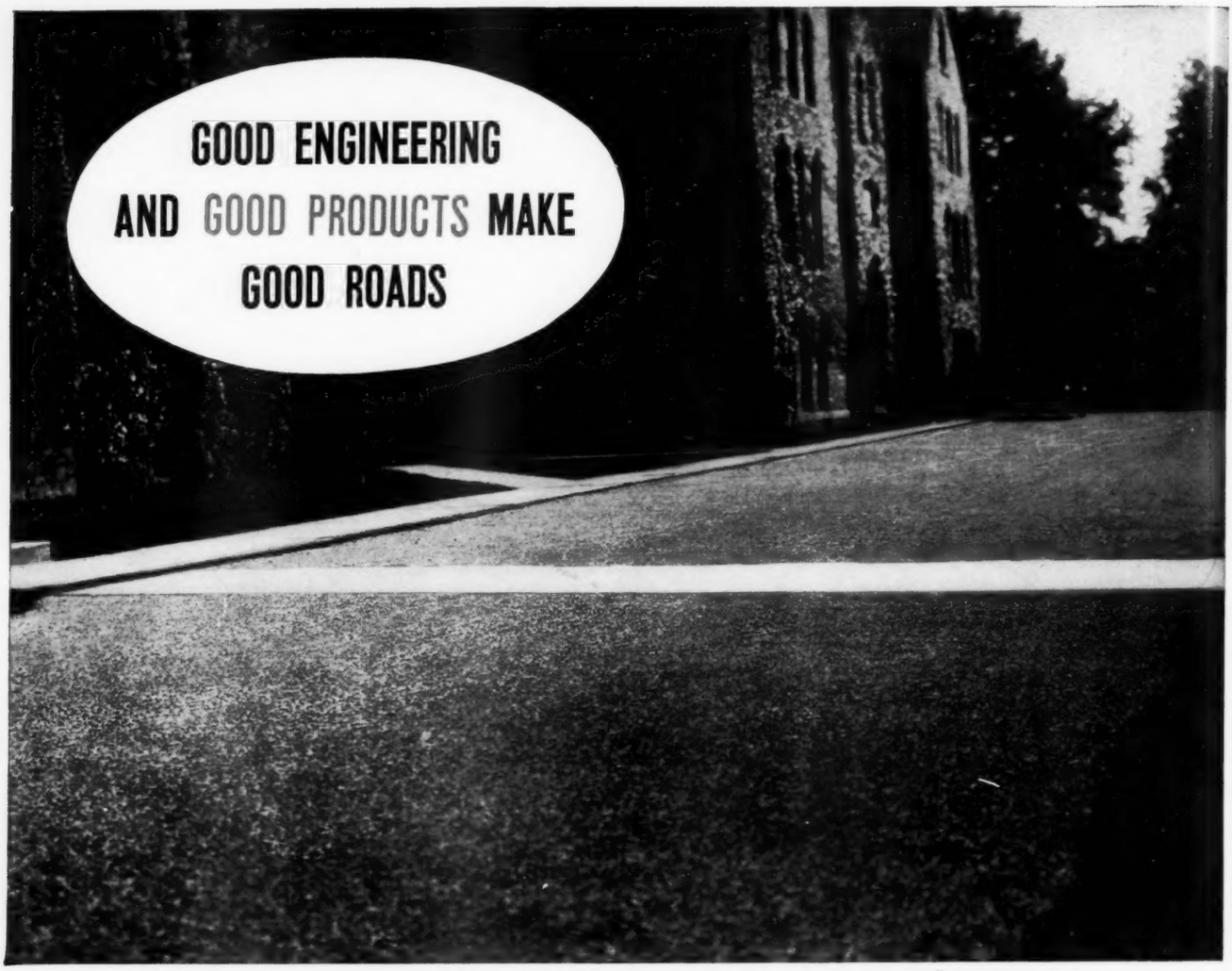

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PUBLIC WORKS

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TIMEWASTERS

Women and Children First:

Some children were given the use of a building to put on a show. The prices charged were as follows: Children, 10 for one cent; women 2 cents each; men 5 cents each. Exactly 100 persons attended and the gate collections was $1. How many of each were accommodated? Contributed by *John E. Quinn.*

The Store of Sin! (or Gin)

The State Liquor Retail Store in D - - r, sold x bottles of gin, the first day it opened, y bottles, the second day, z bottles the third, r, s, t, etc., bottles the following days. The number of bottles sold the sixth day (t) was 70, and on the 12th day, this store of sin sold one bottle of said firewater for each of the 13,680 inhabitants thereof. How many did it sell the first day? (Latest reports were that the inhabitants had decided to buy it out of business.)

The Order of Business Changeth:

Beginning this issue of "TW's" the problems come first. There are those, champing at the bit, who complain about having to wade through old stuff to reach the news. These are the ones who wait with bated breath for each new batch of Timewasters. To keep them from pestering us unduly, we give them a head start over the solution-readers.

Solutions:

Last month we reported that the spacing of the cars to allow the fire truck to operate was 560 feet. G. D. Houtman, one of the top-flight mathematical sharks, has since sent in a solution which shows 404 feet as minimum clear interval and 420 feet a center-to-center distance.

Mikey and Ikey didn't cause much trouble this time. The end of the latter's shadow travels at 10 mph, and the end of his shadow separates from Mikey at the rate of 6 mph. The clock is easy. We worked it out on the train the other day, and, not to be too exact, that clock is on the job just about one day a month.

George F. Key has sent in a fine solution of the "Compass and Straight Edge" problem, which we will reproduce probably next month, on another page.

We Shouldn't Do This:

Against the advice and over the protests of Benny Eisner, we wish this one on the brethern:

$$ghi = V - abcdef$$

Each of the letters represents a digit, 1, 2, 3, 4, 5, 6, 7, 8, and 9. There is no 0. Mr. Eisner says there are two answers and no logical solution. Well, anyway, we had lots of fun getting one of those answers, and we hope likewise for you.—W. A. H.

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A. PRESCOTT FOLWELL, *Editor* **W. A. HARDENBERGH,** *Asso. Editor*

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PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 65 — *November, 1934* — No. 11

Elutriation of Sludge Greatly Increases Effectiveness of Coagulants

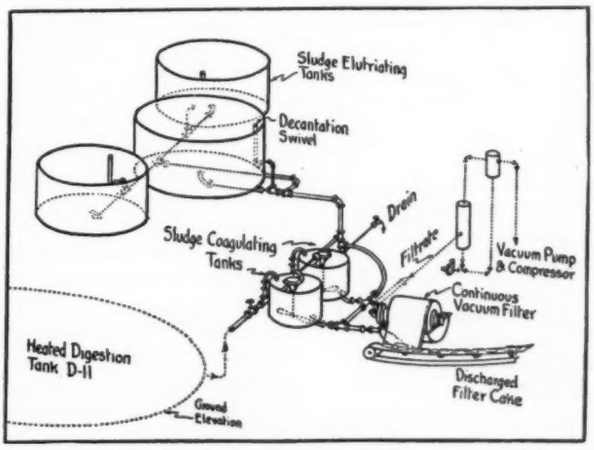
Baltimore tests indicate it can reduce its cost of sludge disposal more than fifty percent by elutriation and vacuum filtration.

PERHAPS the most interesting of the results of recent investigations of sewage treatment methods are those which have been obtained at the Baltimore sewage works in their experiments with "elutriation."

A. L. Genter, consulting chemical engineer, during the past few years has been conducting an exhaustive group of laboratory investigations with a view to finding means of reducing the amount of coagulant needed to flocculate sewage sludge. It has been found that digested sludges require more coagulant per unit of dry substance for economic coagulation than do fresh raw sludges, and his studies seem to demonstrate that resistance of sludges to coagulation with relatively small amounts of coagulants is due largely to the soluble decomposition products generated in sludges and accumulated in the liquid surrounding the sludge particles. This liquid, during biological processes of decomposition, becomes relatively rich in ammoniacal compounds, some of which are adsorbed by the colloids and capillary active surfaces or by the active hydrogen ions of such colloids and surfaces. These ammoniacal compounds react chemically with ferric coagulants intended for floculating the colloids, thus necessitating more coagulant than is necessary for floculation of the colloids alone.

The simplest method of decreasing the concentration of the soluble decomposition compounds he found to be diluting the sludge with relatively pure water, or water containing active chemicals or exchange adsorbents, then allowing the sludge to settle and decanting the supernatant liquid. This process he termed "elutriation." His experiments and results he described in the July 1934 issue of "Sewage Works Journal."

These laboratory experiments were followed by field experiments which were conducted at the Baltimore sewage works, beginning August 29, 1933, and continued for more than nine months by C. E. Keefer, principal assistant engineer, and Herman Kratz, Jr., junior chemist, Baltimore Bureau of Sewers, who have described the experiments and their results at length in a paper before the New York State Sewage Works Association.



Layout of plant for elutriation and filtration tests at Baltimore.

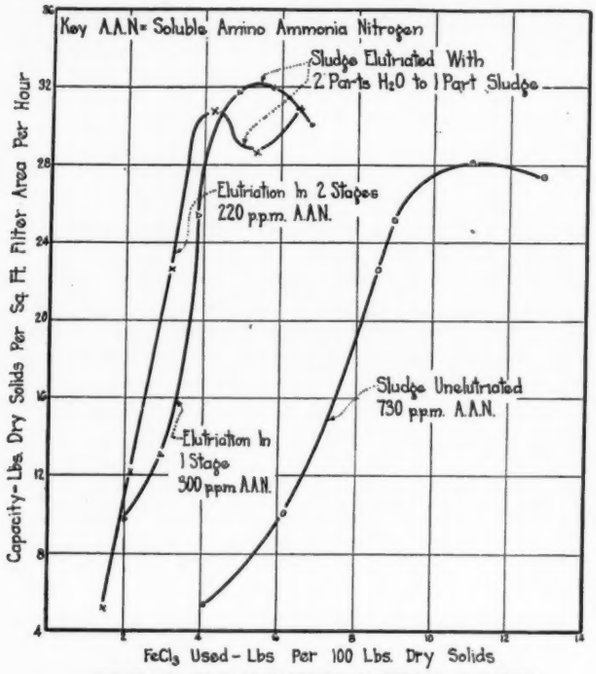
These extensive field experiments, which comprised 330 separate runs, seemed to confirm quite closely the laboratory work. They consisted of filtering sludges before and after various percentages of the soluble ammoniacal compounds had been removed, using for this purpose both digested and raw sludges and mixtures of the two. Vacuum filters were used, the sludges being coagulated before filtration; and the effectiveness of four different coagulants was observed, but most of the work was done with ferric chloride. Based on these experiments, estimates were made of the cost of filtering the digested sludge at Baltimore, which amounts to approximately 60,000 lb. of dry solids daily.

In their report on this investigation, Keefer and Kratz designate the amount of soluble amino acids and ammoniacal compounds resulting from sludge decomposition by the concentration of nitrogen, which they call amino-ammonia nitrogen (abbreviated to a. a. n.). This usually varies from 50 to 100 ppm in fresh sludge from a preliminary settling tank, but increases to 700-1,000 ppm when the solids are digested.

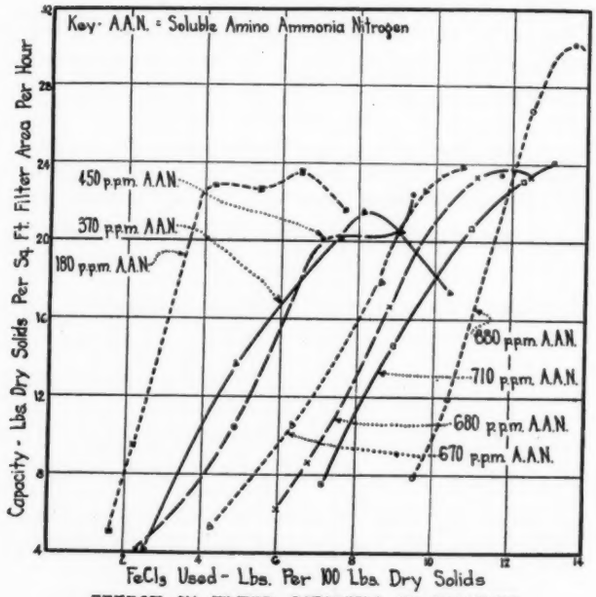
Elutriating sludge (6.5 to 6.7% solids) with an equal volume of water reduced the a. a. n. from 783 to 440 ppm. Using twice the amount of water reduced it to 294 ppm, and three volumes of water to 168 ppm. These reductions reduced correspondingly the amount of coagulant required to produce a given amount of filter cake; or, using the same amount of coagulant, increased the amount of filter cake. For producing 8 lb. of dry solids per square foot of filter area per hour, 5.4 lb. of ferric chloride per 100 lb. of dry solids in the sludge was required for unelutriated sludge, but only 1.6 lb. when the sludge had been elutriated with three volumes of water. Or when unelutriated sludge was coagulated with 6 lb. of anhy-

drous ferric chloride per 100 lb. of dry solids, the filter capacity was 10.2 lb. of dry solids per sq. ft. of filter area per hour, but the same amount of the same chemical used with elutriated sludge increased the capacity to 26.6 lb., or 2.6 times as great.

It was found that when two volumes of elutriating water were used in two successive operations, first elutriating with one volume, settling and removing the supernatant; then elutriating with another volume of fresh water, the reduction of amino-ammonia nitrogen was increased from (734-302 ppm) 432 ppm obtained by one elutriation with two volumes of water to (734-217 ppm) 517 ppm with the two-stage elutriation.


Key A.A.N.= Soluble Amino Ammonia Nitrogen
Sludge Elutriated With 2 Parts H_2O to 1 Part Sludge
Elutriation In 2 Stages 220 ppm. A.A.N.
Sludge Unelutriated 730 ppm. A.A.N.
Elutriation In 1 Stage 300 ppm A.A.N.
Capacity - Lbs. Dry Solids Per Sq. Ft. Filter Area Per Hour
$FeCl_3$ Used - Lbs Per 100 Lbs. Dry Solids

EFFECT OF ELUTRIATING DIGESTED SLUDGE IN 1 AND 2 STAGES ON FILTER CAPACITY


Key- A.A.N. = Soluble Amino Ammonia Nitrogen
450 ppm. A.A.N.
370 ppm. A.A.N.
180 ppm. A.A.N.
680 ppm. A.A.N.
710 ppm. A.A.N.
680 ppm. A.A.N.
670 ppm. A.A.N.
Capacity - Lbs. Dry Solids Per Sq. Ft. Filter Area Per Hour
$FeCl_3$ Used - Lbs. Per 100 Lbs. Dry Solids

EFFECT ON FILTER CAPACITY OF REDUCING AMINO AMMONIA NITROGEN
Series No. 1

In one experiment several successive elutriations (number not stated) reduced the a. a. n. to 95 ppm, and the sludge yielded 5.4 lb. of dry cake per sq. ft. of filter area with the remarkably low dose of 1.0 lb. of ferric chloride. It is not believed, however, that use of more than 2 or 3 volumes of elutriating water would be economical.

When raw and digested sludge, both unelutriated, were mixed in equal proportions, the maximum filter capacity obtainable was 6.5 lb. per. sq. ft., using 5.1 lb. of ferric chloride—much less than for digested sludge alone. When elutriated digested sludge was mixed with an equal volume of raw sludge a much higher filtration rate was obtained than with unelutriated digested sludge alone. The raw sludge used was 5 or 6 days old, fresh sludge being unobtainable. It is thought that results equal to those from digested sludge could be obtained with raw sludge only 1 or 2 hours old, which would have a low a. a. n. content.

With elutriation, the elutriating water remains to be disposed of. In Baltimore, treating 76.35 mgd of sewage, the elutriate would be 292,000 gal. daily, containing a B.O.D. of 158 ppm. The most satisfactory way of disposing of this would be to pump it into the raw sewage, which would increase the B.O.D. load on the sewage works by only 0.24%.

Comparison of Coagulants

Although most of the tests were made with ferric chloride, a number were made using chlorinated copperas, ferric sulphate, and "Calcoag" (75% ferric sulphate). The amounts of the several coagulants needed per 100 lb. of dry solids to produce 8 lb. of dry cake per square foot of filter area from unelutriated sludge were as follows: Ferric chloride, 5.0 lb.; chlorinated copperas, 6.7 lb.; ferric sulphate, 12.2 lb.; Calcoag, 18.5 lb. With 2-stage elutriated sludge the quantities were 1.8 lb., 2.5 lb., 8.4 lb. and 4.3 lb. respectively. As the prices of these vary, however, the relative costs are not represented by these figures. For example, in Baltimore ferric chloride cost 2.2 c. a pound and chlorinated copperas 1.14 c. According to E. B. Besselievre, Providence, R. I. can obtain ferric chloride, made near the plant, for less than 2c.; while Birmingham finds chlorinated copperas economical because of the abundant supply of ferrous sulphate at very low cost and a low price for delivered chlorine.

Costs

The ultimate purpose of sludge elutriation is to reduce the cost of sludge dewatering. Elutriating requires additional tanks and other equipment, but saves in cost of coagulant and handling same, and reduces the required area of vacuum filter (which costs $60 to $70 a square foot) or of sludge beds.

Estimates of the costs of sludge dewatering plants for Baltimore gave a total of $139,000 for installation, and $3.38 operating costs per ton of dry solids if elutriation is used; while without elutriation the cost was estimated at $4.22 to $5.00 a ton. (These unit costs include interest and depreciation, one operator, coagulant, power, oil, repairs, etc.) These figures are for vacuum filtering. It actually costs Baltimore an average of $6.13 per ton of dry solids to air-dry the sludge on uncovered beds. A saving of $30,100 a year is estimated from elutriating and vacuum filtering, as compared to air-drying unelutriated digested sludge.

A Pennsylvania Rural Road before and after improving with a low-cost pavement

How Pennsylvania Secures Good Roads at Low Cost

By P. M. Tebbs

Assistant Chief Engineer, Pennsylvania Department of Highways

WHEN, on August 15, 1931, the Pennsylvania Legislature added something over 20,000 miles of rural roads to the State highway system, the Department of Highways, being confident that general approval of the proposition assured its adoption, had already made preliminary preparations for carrying it out. Before the legislation was passed it had authorized a program of light-type construction on 800 miles of suitable highways on the old State highway system, distributed in all the counties, for the purpose of gaining experience and training its organization for this class of work.

The Department constructed certain light-type pavements with its own forces but found that the field engineers did not consider it practicable to construct these roads for less than some ten or twelve thousand dollars per mile. It was necessary to reduce these costs and, after some preliminary studies by the headquarters staff engineers, tentative standards or types, specifications, plans and methods of procedure were prepared, and the field engineers called in for a conference. The whole subject was treated as a new undertaking rather than a modification of existing construction specifications and procedure, so that, by getting down to fundamentals, engineering and construction costs might be reduced to an economic minimum. If this were not done, the tendency of our organization, trained in high-type construction, would be toward too much refinement in specifications, plans and construction details, which would not produce the necessary low cost for this type of work.. The wisdom of thus revamping the whole procedure was demonstrated by the fact that we have been able to construct thousands of miles of better low-cost roads for an average cost of $6,000 a mile, exclusive of bridges; these roads having a depth of approximately 8 inches, a width of 14 feet, with bituminous treated surfaces, the roadway being graded approximately 22 feet wide and provided with drainage structures.

The following tabulation shows the status of these roads on August 1, 1934:

Rural Road System

Improved as of 8-15-31	3,070
Reclamation	1,609
New construction completed or programmed to date	8,790
Total miles on system	20,170
Total cost of new construction	$57,328,380
Average cost per mile	6,522
Total cost of reclamation	$ 2,847,930
Average cost per mile	1,770
Total cost of new construction, reclamation	$60,176,310
Average cost per mile	5,787

The term "reclamation" is applied to the unsurfaced type of roads which had been improved previously by the local authorities with materials which were suitable, at least for a base course, but which had not been maintained properly as improved roads. These are scarified, reshaped, additional materials added as required, and a bituminous surface placed.

On the new construction, the overhead costs were as follows: Plans and surveys—total, $2,373,300 or $270 per mile. Inspection and general overhead—total $4,263,150 or $485 per mile.

Plan and survey costs have increased considerably during the past two years due to legislation placing property damage upon the State. This requires much time to obtain releases, additional property surveys, search of titles and drafting. Also, much of this work has been done under Federal regulation, requiring complete inspection, final surveys, drafting, etc., as for contracts.

Was this change worth $6,000 a mile?

Experience in Pensylvania has shown that the most important points to be observed in conection with such low-cost road construction are as follows:

1. Any low-cost road without sufficient base course will prove to be expensive.

2. Proper drainage is essential and must be provided.

3. The use of cheap local materials is economical only when the materials are found to be satisfactory. A very thorough investigation and careful control of materials is essential.

4. A careful study of the potential traffic on the highway must be made in order that the improvement (including base, surface, alignment and grade) will be adequate for the traffic which the highway may develop after improvement. In numerous instances in Pennsylvania, rural routes have developed into important by-passes for truck traffic near cities or for crosscuts between important highways.

5. The planning of an extensive program of low-cost road improvement must include proper consideration of future maintenance costs, and a tentative budget should be set up including these charges, in order that such consideration may be given.

Survey Procedure

In making surveys for construction of low-cost roads, the Pennsylvania Highway Department has developed the procedure described in the following paragraphs, which has been made as simple and economical as possible, with due regard to general principles of accuracy:

Alignment: The alignment of the existing roadway should be followed generally, with such modifications as will tend to reduce hazards of alignment, sight distance and grade, and reduce costs of construction by shortening distance or decreasing grading quantities.

The district engineer or a qualified assistant should make an inspection of the roadway before the survey is started, ascertaining the width of legal right-of-way, and determine as closely as possible the various control points as well as any modifications or revisions in alignment or grade which he deems advisable, making definite notes of such by reference to the mileage record stations or other definite objects along the roadway, so that the notes can readily be interpreted and followed by the party chief.

In establishing the alignment, particular attention must be given to economic grading cost and as far as practical to locating the entire pavement surface on firm ground. Particular care must be used in fixing the center line on sections where the existing roadway is narrow, in order to establish the line so as to secure the best results with the least amount of grading, this being very essential on steep hillside locations.

A traverse center line survey of the proposed location is to be run by the survey party. Bearings should be determined, checked and recorded for all tangents and long chords.

The beginning and end of the survey and all intermediate transit points, including P. I's, P. C's and P. T's, should be referenced accurately so that the line may be re-established. (This may not be possible in all cases.)

Offset stakes are to be set at the survey stations, including breaks in grade.

Curves up to 16 degrees shall be staked on 50-foot cords; over 16 degrees, on 25-foot cords or shorter, as conditions warrant.

All stakes should be set so that they may be used for the construction of the roadway.

Center line on tangents should be run to a point where a curve approximately starts, or to P. I. intersections, and a random curve should be run in, and the station chaining continued ahead on the curve. (Two methods of running random curves are shown herewith.)

Curve data should be shown in the notebook in practically the same manner as for regular curves, except that the transit points on the curve and the lengths of long cords should be recorded clearly and definitely.

Topography: This work should be simplified as much as possible. It should be recorded by stational plusses and offset distances from the survey center line. Pole lines and fences should be located on tangents by giving stational plusses and the offset distances to the poles or fence points nearest the ends of the tangent and at any intermediate points where there may be a break in the line of poles or fence. Intermediate poles in a straight line can be located by stational plusses only. On curves they should be located by individual plusses and offset distances. Individual trees should be located by stational plusses and offset distances, and the kind and size recorded. Angles of connecting roads, driveways, property lines, etc. may be determined by pocket compass and only sufficient topography be taken on these as may be affected by construction.

The edges of the traveled roadway should be located by offset distances from center line at all stakes and intermediate breaks in line of traveled-way. In heavy through cuts and on hillside sections, the edge of ditch or bottom of cut, and the top of embankment should be located in the same manner as the traveled-way, this being done to show more readily the existing graded width of roadbed at such critical locations.

The fronts of buildings and appurtenances which are within 50 feet (or more if necessary) of the center line should be located by plusses and offset distances, and names of all property owners recorded.

In built up sections all structures within the roadway limits, also curbs, sidewalks and building lines, should be located and recorded.

County, township, borough and other legal sub-division lines should be located definitely as to stational plusses, and angle of intersection with the survey center line by pocket compass where practical; also all utilities such as railroad, railway, pipe lines, etc. should be located accurately and recorded with names of railroad, etc. and owners.

Complete data should be secured for all culverts; the location, skew, size and length, etc. to be carefully recorded for each.

Surveys for bridges should follow standard practice as outlined for Preliminary Surveys in the Survey Manual.

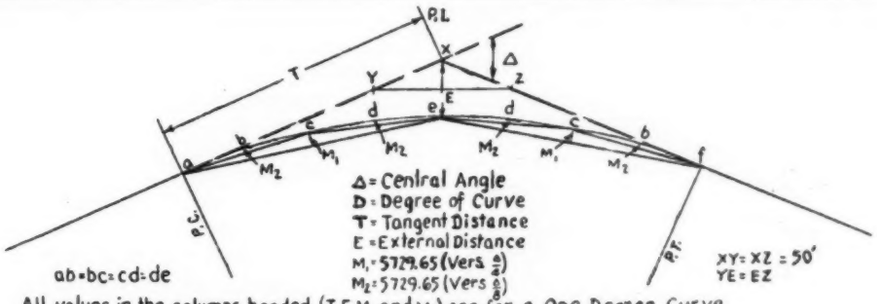
Where modifications or revisions of alignment are made which will require additional or new right-of-way, sufficient data must be secured to permit of the satisfactory plotting of drawings for condemnation of the required property.

Profile: Bench marks should be established in the standard manner as for preliminary surveys, to the nearest .01 of a foot. Profile reading to the nearest .1 of a foot should be taken by means of a wye level for all center line points opposite stakes at stations and intermediate breaks. Readings should be taken and recorded to the nearest .01 of a foot for tops of all offset stakes and nearest .1 of a foot for ground elevations at stakes. Elevations should be taken of flow lines of pipes and small culverts, and profiles of the ground or stream line extended for a distance of at least 50 feet beyond each end of the pipe or culvert. Profiles should be taken at low points or other advisable locations in like manner, if no culvert exists at present. Profiles should be plotted in the field if practical, to facilitate the establishment of an economical grade line and the correct location of drainage culverts and ditches.

At intersecting roadways, drives, etc., profile elevations should be taken for such distances as may be affected by construction.

At railroad and railway crossing or where parallel to the roadway, elevations should be taken in the standard manner for preliminary surveys.

Cross-sections: In cases where heavy grading is deemed advisable to reduce steep grades, to secure necessary width in heavy cuts or on hillsides, or on relocations, where it is required to load and haul a considerable amount of material, standard cross-sections must be taken and standard construction drawing made.



All values in the columns headed (T, E, M_1 and M_2) are for a One Degree Curve
Divide all values in those columns, by the Degree of Curve used.

YZ	Δ (in Deg.)	T	E	M_1	M_2	YZ	Δ (in Deg.)	T	E	M_1	M_2	YZ	Δ (in Deg.)	T	E	M_1	M_2
100.0	1°	50.0	0.2	0.1	0.0	94.8	37	1917.1	312.2	74.5	18.7	80.4	73	4239.7	1398.0	288.2	72.5
100.0	2	100.0	0.9	0.2	0.1	94.6	38	1972.9	330.1	78.6	19.7	79.9	74	4317.6	1444.6	296.1	74.5
100.0	3	150.0	2.0	0.5	0.1	94.3	39	2029.0	348.6	82.7	20.7	79.3	75	4396.5	1492.4	304.1	76.5
99.9	4	200.1	3.5	0.9	0.2	94.0	40	2085.4	367.7	87.0	21.8	78.8	76	4476.5	1541.4	312.2	78.6
99.9	5	250.2	5.5	1.4	0.3	93.7	41	2142.2	387.4	91.4	22.9	78.3	77	4557.6	1591.6	320.3	80.6
99.9	6	300.3	7.9	1.9	0.5	93.4	42	2199.4	407.6	96.0	24.1	77.7	78	4639.8	1643.0	328.7	82.7
99.8	7	350.4	10.7	2.7	0.7	93.0	43	2257.0	428.5	100.6	25.2	77.2	79	4723.2	1695.8	337.0	84.9
99.8	8	400.7	14.0	3.5	0.9	92.7	44	2314.9	450.0	105.3	26.4	76.6	80	4807.7	1749.9	345.6	87.0
99.7	9	450.9	17.7	4.4	1.1	92.4	45	2373.3	472.1	110.1	27.6	76.0	81	4893.6	1805.3	354.1	89.2
99.6	10	501.3	21.9	5.4	1.4	92.1	46	2432.1	494.8	115.1	28.8	75.5	82	4980.7	1862.2	362.9	91.4
99.5	11	551.7	26.5	6.6	1.6	91.7	47	2491.3	518.2	120.0	30.1	74.9	83	5069.2	1920.5	371.6	93.7
99.5	12	602.2	31.6	7.8	1.9	91.4	48	2551.0	542.2	125.2	31.4	74.3	84	5159.0	1980.4	380.6	96.0
99.4	13	652.8	37.1	9.2	2.3	91.0	49	2611.2	566.9	130.5	32.7	73.7	85	5250.3	2041.7	389.6	98.2
99.3	14	703.5	43.0	10.7	2.7	90.6	50	2671.8	592.3	135.8	34.0	73.1	86	5343.0	2104.7	398.7	100.6
99.1	15	754.3	49.4	12.3	3.1	90.3	51	2732.9	618.4	141.3	35.4	72.5	87	5437.2	2169.2	407.9	102.9
99.0	16	805.2	56.3	14.0	3.5	89.9	52	2794.5	645.2	146.9	36.8	71.9	88	5533.1	2235.5	417.2	105.3
98.9	17	856.3	63.6	15.8	3.9	89.5	53	2856.7	672.7	152.5	38.2	71.3	89	5630.5	2303.5	426.6	107.7
98.8	18	907.5	71.4	17.6	4.4	89.1	54	2919.4	700.9	158.3	39.7	70.7	90	5729.7	2373.3	436.1	110.1
98.6	19	958.8	79.7	19.7	4.9	88.7	55	2982.7	729.9	164.2	41.2	70.1	91	5830.5	2444.9	445.8	112.5
98.5	20	1010.3	88.4	21.8	5.4	88.3	56	3046.5	759.6	170.2	42.7	69.5	92	5933.2	2518.5	455.5	115.1
98.3	21	1061.9	97.6	24.1	6.0	87.9	57	3110.9	790.1	176.3	44.2	68.8	93	6037.8	2594.0	465.3	117.5
98.2	22	1113.7	107.2	26.4	6.6	87.5	58	3175.0	821.4	182.5	45.8	68.2	94	6144.3	2671.6	475.2	120.0
98.0	23	1165.7	117.4	28.8	7.2	87.0	59	3241.7	853.5	188.8	47.4	67.6	95	6252.8	2751.3	485.2	122.6
97.8	24	1217.9	128.0	31.4	7.8	86.6	60	3308.0	886.4	195.2	49.0	66.9	96	6363.4	2833.2	495.3	125.2
97.6	25	1270.2	139.1	34.0	8.5	86.2	61	3375.0	920.1	201.7	50.7	66.3	97	6476.2	2917.3	505.6	127.8
97.4	26	1322.8	150.7	36.8	9.2	85.7	62	3442.7	954.8	208.4	52.3	65.6	98	6591.2	3003.8	515.9	130.5
97.2	27	1375.6	162.8	39.7	9.9	85.3	63	3511.1	990.2	215.1	54.0	64.9	99	6708.6	3092.7	526.3	133.1
97.0	28	1428.6	175.4	42.7	10.7	84.8	64	3580.3	1026.6	222.0	55.7	64.3	100	6828.3	3184.1	536.8	135.8
96.8	29	1481.8	188.5	45.8	11.5	84.3	65	3650.2	1063.9	228.9	57.5	63.6	101	6950.6	3278.1	547.4	138.5
96.6	30	1535.3	202.1	49.0	12.3	83.9	66	3720.9	1102.2	235.9	59.3	62.9	102	7075.5	3374.9	558.1	141.3
96.4	31	1589.0	216.2	52.3	13.1	83.4	67	3792.4	1141.4	243.1	61.1	62.3	103	7203.1	3474.4	569.0	144.0
96.1	32	1643.0	230.9	55.7	14.0	82.9	68	3864.7	1181.6	250.4	62.9	61.6	104	7333.6	3576.8	579.9	146.9
95.9	33	1697.2	246.1	59.3	14.8	82.4	69	3937.9	1222.7	257.7	64.8	60.9	105	7467.0	3682.3	590.9	149.7
95.6	34	1751.7	261.8	62.9	15.8	81.9	70	4011.9	1265.0	265.2	66.7	60.2	106	7603.5	3791.0	602.0	152.5
95.4	35	1806.6	278.1	66.7	16.7	81.4	71	4086.9	1308.2	272.7	68.6	59.5	107	7743.2	3902.9	613.2	155.4
95.1	36	1861.7	294.9	70.5	17.6	80.9	72	4162.8	1352.6	280.4	70.5	58.8	108	7886.2	4018.2	624.5	158.3

Approximate Methods for Staking Out Curves

Explanation of Method No. 34

Place a stake at the P. I. (shown at X on the sketch) where two tangents or straight lines along the centers of the road, produced, appear to intersect.

Measure 50 feet along each tangent from X to Y and Z and place stakes at these points.

Measure the distance between Y and Z and place a stake midway between these points.

In the table, in the column headed YZ, select the distance nearest to the measured distance, and note corresponding values in columns headed T, E, M_1, and M_2 for a one-degree curve.

Determine the location of the point e, which is on a line extending from X and through the midpoint of YZ, and where it is

desired that the center of the proposed curve shall be located, and measure the distance E between X and e.

By dividing the measured value of E into the above noted tabular value of E, the degree of curve D is determined.

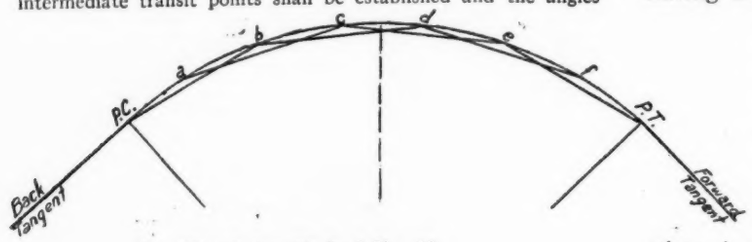
Divide the noted tabular values of T, M_1, and M_2 by D, and lay out the curve by using the resulting distances of T, M_1, and M_2 for this degree of curve as follows:

Measure the above resulting distance T along each tangent from the P. I. shown at X to the beginning of the curve at the P. C. shown at a, also from the P. I. to the end of the curve at the P. T. shown at f.

Next measure the distance between e and the P. C. and locate the midpoint of this line; also locate the midpoint of the line between e and the P. T. in the same manner. At these midpoints measure the above resulting distance M_1 at right angles to said lines, locating points c on the curve, as shown on the sketch.

In a similar manner determine the midpoints of the lines ac, ce, ec, and cf, and measure the above resulting distance M_2 at right angles to said lines, locating points b, d, d, and b on the curve, as shown on the sketch.

When the curve stake-out is completed, the transit is set up on the P. C., a final angle is turned from the back tangent to the P. T., the angle and the long chord being measured and recorded. If it is not possible to see the entire distance along the curve, intermediate transit points shall be established and the angles and chord lengths between transit points measured and recorded.



Sketch for Method No. 33

The transit is then set up on the P. T. and the angle measured and recorded from the P. C., or last transit point, to the forward tangent.

Explanation of Method No. 33

Starting at the P. C., locate points at random by eye, placing stones or temporary stakes at the points selected. Then standing on the P. C., look ahead to B and estimate the offset or middle ordinate distance from A to the chord between the P. C. and B. Then stand on A and sight to C and estimate the offset distance from B to the chord A-C. Proceed ahead on the curve and adjust any irregularities so that the offset distances are uniform. If the middle ordinates are found to differ greatly in two different sections of the curve, then each portion of the curve should be considered as a separate and distinct curve and should be compounded in a gradual manner. The lengths of sub-chords to be used for curves of lesser degree (up to 16 degrees inclusive) should be 50 feet generally; for sharper curves (over 16 degrees) should be 25 feet or shorter as required.

With the transit set on the P. C., angles are read to A, B, C, etc., and the distances chained on the center line of the curve. When the curve stakeout is completed, a final angle should be turned from the back tangent at the P. C. to the P. T., the angle and long chord being measured and recorded. If it is not possible to see the entire distance along the curve, intermediate transit points shall be established and the angles and chords length between transits points measured and recorded. The transit is then set up on the P. T. and the angle measured and recorded from the P. C. or last transit point to the forward tangent.

An alternate method is to chain and adjust the random curve, read the angle at the P. C. from the back tagent to the fartherest visible curve point, divide the deflection angle by the number of curve points desired, and set each intermediate curve point by deflection angles, chaining on the curve from the P. C.; the angle or angles and long chord or chords being recorded as previously outlined.

(To be continued)

Slight Increase in State Gasoline Taxes

State gasoline taxes in the calendar year 1933 yielded a revenue of more than $519,000,000 as compared with $514,138,900 in 1932, according to reports collected from State authorities by the Bureau of Public Roads, U. S. Department of Agriculture. This figure does not include tax returns from the Federal gasoline tax. Consumption of gasoline exceeded 14 billion gallons and was slightly less in 1933 than in the previous year.

Raised Center Stripe Used on Mississippi Paved Roads

A raised center stripe, to be found on many miles of Mississippi pavement, is an innovation of the Maintenance Department of that state. It is composed of aggregate (crushed stone, gravel or slag) bound to the surface of the pavement with a bituminous binder and is applied in one operation. The stripe is about 3/8th inch thick and can be made from three to eight inches wide. The machine which does this work was built in the Highway Department's shops at Jackson, Mississippi, having been designed by Sam J. Dalton, engineer of maintenance, and built by J. S. Fussel, head mechanic at these shops. This machine is a single unit, which cleans the pavement, applies the bitumen uniformly, applies the aggregate on the bitumen, and strikes off same evenly, and then rolls or compresses the aggregate into the bitumen.

The raised stripe is said by the department to be much more economical than any other, since its life is several times that of a stripe made of any known paint. However, the chief advantage of this stripe is not its economy but the fact that it adds to the safety of the traveling public in that it is more visible at all times, especially at night, and more especially when it is raining at night (the time when a center stripe is most needed). It is not necessary for the driver to dim his lights on pavements which have the raised center stripe. If he will keep his eye on the center stripe, he will not be blinded by the lights of other cars, neither will there be a "blind spot," but his vision will be such that he will know at all times his position on the pavement.

This stripe, being slightly raised, also reminds the driver when he goes over the center of the road and thus becomes a "road-hog." A few drivers always stay on the right-hand side of the road but some drivers become "road-hogs" without realizing it and this gentle reminder will suffice for them. Of course, no stripe will prevent deliberate road hogging.

Specifications for Photographs of Construction Progress

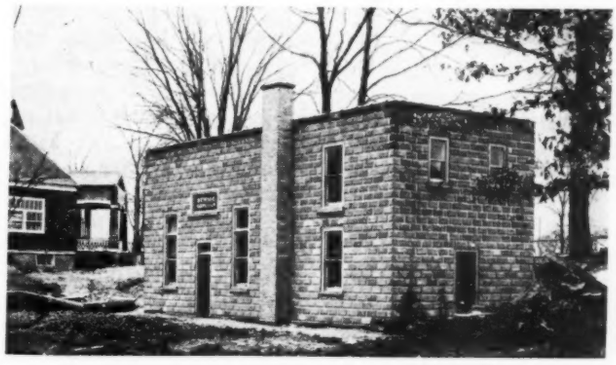
In calling for bids for steel pontoons and other equipment, the U. S. Engineer Department has inserted in their specifications provisions regarding monthly photographs of the work. The paragraph covering this is given below. With the change of a few words, it would be equally applicable to almost any job.

Photographs.—After work has been started, suitable photographs shall be taken on the first of each month, or as soon thereafter as practicable. Sufficient views shall be taken to show clearly the rate of progress of all work. Photographs shall be 8 inches by 10 inches in size, mounted on linen, with one inch margin at left hand side of photographs for binding, and shall be first-class in every particular. Upon the completion of the work and just prior to the delivery, a broadside photograph shall be taken. Two copies of each view shall be furnished the contracting officer as soon as practical after being taken. Each photograph shall contain upon its face the date, name of contractor, type of vessel, and title of view taken.

Non-Bacterial Sewage Treatment at City of David

THE sewage of the City of David, Michigan, a small religious colony outside the corporate limits of Benton Harbor, has been treated by a strictly non-bacterial process since December 14, 1933. The amount treated during the four months May to August, inclusive, has increased from a minimum of 15,000 gallons per day in May to a maximum of 90,000 in August; the average for the latter month being 83,000 gpd.

The plant consists of a receiving well, where the sewage is dosed with hydrated lime and carbon (derived from the process itself, as described later) and passed through a shredder screen, whereby all organic solids are reduced to a size not greater than ⅛ inch; from here it is pumped to a mixing trough in which ferric chloride is mixed with the sewage; a clarifying tank, in which the coagulated solids are deposited; a chlorinator, aerators, and rapid sand filters for treating the effluent; while the sludge is dewatered by a vacuum filter and subjected to destructive distillation in heated air-tight retorts; the gases from this distillation being separated from the liquid in a condenser and separating tank and used for fuel, while the liquid is drawn off. The solids left in the retorts are a carbon compound produced by the distillation, and are reduced to a fineness of 200 mesh by passing them through a ball mill and fed into the raw sewage as described above.



Building housing sewage treatment plant. Auditorium 60 ft. away at the left.

The entire plant is enclosed within the walls of a building 18 by 46 feet, and all except the receiving well is above ground. This building is located nearly in the center of community and within sixty feet of the church, being neither offensive nor unpleasantly suggestive to either sight or smell. The effluent is discharged into a small creek which flows through an amusement park and playground where as many as 2,000 people gather in summer. During July and August of this year this creek entirely dried up above the plant and undiluted effluent flowed through the park, but at no time were there detectable odors arising therefrom, nor did any sludge deposit in the creek.

The city owns a municipal power plant, furnishing light and power for residences and for a laundry, machine shop, garage, printing presses, bakeries and canneries. The necessity of sewers was realized several years ago, but not until the fall of 1933 were the authorities able to select a plant which would give the necessary purity of effluent and absence of odor. The building is built of concrete blocks. The interior walls are in pure white done in textone with trim in light green. The tanks, of welded steel, are painted in aluminum, the pipes in black, valve wheels in crimson and chemical feed machines in black and gold. From the receiving well to the outlet, the sewage is enclosed and out of sight.

The hydrated lime (average dose, 192 lb. per m.g.) and the carbon compound (214 lb. per m.g. average dose) are added as the sewage enters the receiving well for the purpose of deodorization. An average of 108 lb. per m.g. of ferric chloride is applied as a coagulant. The carbon is believed to absorb gases and adds weight to the suspended matter, giving rapid precipitation.

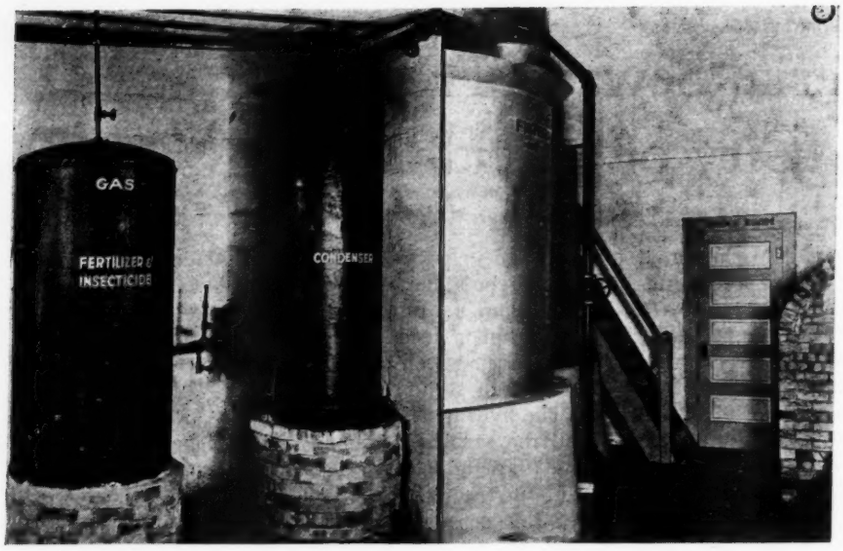
The clarifying tank is cylindrical with a conical bottom, with a vertical partition about ¼ diameter from the inlet end and extending to within one foot of the top of the conical bottom. The coagulated sewage flows down to the bottom of this partition, deposits the sludge in the hopper, flows up to the overflow weir, where H.T.H. is applied, and into two small tanks with perforated bottoms. Falling through this bottom as spray, it is aerated and falls into two rapid sand filters. The effluent from these is discharged into the creek.

The sludge is drawn from the bottom of the clarifying tank by hydrostatic pressure and dewatered by a vacuum filter, the filter water and approximately 5% of the sludge being returned to the receiving well. The dewatered sludge cake is passed to the retorts, which are housed in fire brick and heated by means of oil supplemented by the gas from the retort. The liquid drawn from the bottom of the separating tank has been found to be very effective as an insecticide and fertilizer and the colony used it for spraying its orchards, greenhouses and truck fields.

The amount of chemicals used during nine months of operation averaged 192 lb. of lime, 108 lb. of ferric chloride and 5¼ lb. of H.T.H. per million gallons. The total cost of chemicals and of fuel averaged $6.14 per m.g.

If, during cold weather, it is not considered necessary to produce an effluent of such high quality, the chemical can be reduced or entirely eliminated; and during hot months they would probably be increased above these averages.

Excess quantities of crank case oil have been dumped into the clarifying tank and were carried down with the sludge and carbon, none appearing in the effluent.



Sludge vapor from retort is piped into top of condenser and from this to gas tank, where liquid drops to bottom, reabsorbing the ammonia gas.

Aerators at top left, spraying into rapid sand filters. At right, end of retort and Oil-O-Matic burner.

On several occasions ground garbage has been placed in the influent sewage and disposed of by the plant without difficulty.

One man looks after the plant, spending three or four hours a day keeping it clean, filling the chemical feeds and oiling the motors and pumps. A chemist collects samples daily and analyzes them. The average results for August, the month of greatest flow, were as follows:

pH, raw, 7.4; effluent, 7.2. B.O.D., raw, 294; effluent, 19. Total solids, raw, 1422; effluent, 461. Total suspended solids, raw, 748; effluent, 24. The effluent contained 0.058 parts nitrates and 0.01 nitrites; 2.4 parts NH_3; 1.2 parts dissolved oxyxgen and had a stability of 18.

The plant was designed by A. R. Putnam of Valparaiso, Ind. The operator is John W. Henline, and H. L. Galekause is chemist.

Sand Trap for Self-Cleaning of Canals and Streams

A flowing stream can now be forced to clear itself as it flows. In the West, sand, silt, and sediment in streams present serious problems, especially to irrigators but also to power companies and to municipal water supply systems. R. L. Parshall, engineer of the U. S. Department of Agriculture, has developed three different types of sand traps, by which a small part of a stream can be diverted through them to carry out of the main stream a concentrated load of sand, silt, and debris. Mr. Parshall described in detail the installation and operation of these devices at the joint meeting of the American Society of Agricultural Engineers and the Hydrology section of the American Geophysical Union at Berkeley, California, June 21.

The traps vary widely in construction, are relatively inexpensive, and each is designed to force a stream to clear itself under certain conditions of flow. The vortex tube trap is for use in relatively swift streams, the riffle deflector in moderate currents and the grating trap in gentle currents. In each, the sandy material is concentrated into a small stream which is wasted from the main stream and thus deposits its load of sand and sediment on an area where it will do no harm. It pays to sacrifice a small part of the water in order to clear the remainder.

The vortex trap consists of a tapered tube in the floor of a flume built in the canal. The tube lies diagonally across the stream and has a wide slit the full length of its upper side which is placed level with the floor of the flume. The bedload of sand and gravel traveling down the channel is caught by the whirling body of water inside the tube device and conveyed to a discharge outlet in the side or bottom of the structure. Three installations in large canals have proved effective.

The riffle-deflector type consists of a series of curved vanes set on the bottom of a ditch or canal. Each vane is curved into approximately a 90-degree arc of a circle. The vanes when set in a line normal to the current and properly spaced, will move the bed load across the stream to an opening in the side wall of the channel, where a small stream carries it out. One installation of the riffle-deflector has been made in a canal and functions satisfactorily when the vanes can be kept rid of such debris as tins, paper cartons, and other trash.

The grating type of trap is relatively new, and consists of a series of straight or curved vanes set on the floor of a flume normal to the stream flow and uniformly spaced, with top edges inclined downstream. The sand particles are drawn down behind the top edge of the device and retained there so that through the force of gravity they may settle vertically into a suitable receptacle below the grating in the floor of the flume.

Saving Meters From Hot Water Troubles

As noted in the "Water Wheel" for September, Los Angeles has had trouble with damage of water meters by hot water. In writing of this, Mr. Read said that if a satisfactory heat-proof piston can not be made, meter protection valves should be used "if they can be perfected," these releasing hot water through a fusible plug if such water should reach the meter.

Wm. H. Trentlage, Commissioner of Public Health and Safety and Superintendent of the Water Department of Elgin, Ill., has written us in reference to this, saying that Elgin experienced much the same trouble but has overcome it by compelling people to install "Autotherm" relief valves, which releases water from the water line whenever the water therein exceeds either a certain pressure or a certain temperature (205 degress, we believe). "We have this installed on the water pipe close to the hot water heater, so that as soon as the water begins to back up owing to temperature causing back pressure, the safety valve releases and the hot water does not back up beyond this point, and cold water from outside or from the water mains begins to flow in. This saves the cost of repairs on meter. The cost of taking care of the safety valve is very small compared to cost on meter. We passed a city ordinance that the valve must be installed on all new work or wherever repairs are made on meter, furnace, or lines between meter and furnace."

One Man's Ideas About Street Designing

By D. Y. Bate

PART 2. PLATTING PROFILE

This is the second of the articles by Mr. Bate discussing problems and details of street design. The first appeared in the October issue. Readers are invited to contribute their own "kinks" and ideas.

Checking

UPON receipt of the note book, a check should be made against the record maps of the district to see that center line lengths are correct, street widths conform to dedicated widths, and that correct names are on all intersecting streets. The level note reduction should then be checked and at the end a note made to denote the date of check and initialed by the checker.

Platting the Plan

The writer prefers to plat the plan as the next step. This should be placed so that the center line is about five inches above the bottom of the profile cloth and so that the stations on the plan are opposite the stationing on the profile. Keep the North or East end of the job to the right of the cloth, allow about twenty-two inches at the right for the title, approval stamps, typical cross-sections and special details to be placed there by the designer.

Make your property lines fairly heavy, show existing improvements in light dashed lines. For street names and the stationing of the street intersections the writer uses a brass stub pen without a vent.

Names of streets should be lettered in neatly but not too large, as the designer has quite a lot of data to put in the intersecting streets when the profile comes to him. It is preferable to write in pencil the name of the street of which the plan and profile are being made so that, when the designer starts putting in his details on the plat, he can erase the pencil name and place it later in ink where it will least interfere with his details.

Place a North point near the plat; on long plats (3000′) use two North points. These points should be of moderate size (3.25″ over all) and very plain. It is a waste of valuable time to make elaborate North points. A maximum of 12 feet should be the length of a completed profile. A convenient scale for platting the plan is 1″ equals 40′, especially if using Plate A profile paper.

Platting Profile of Ground Lines

The profile of the ground at the property lines should next be platted, above the plan and to the same horizontal scale as the plan. On fairly level streets a vertical scale of 1″ equals 4′ is quite convenient, and on streets with steep gradients a vertical scale of 1″ equals 8′ will save making the "breaks" too frequent. Try to so arrange your datum that "breaks" will fall at street intersections.

Indicate stations on the heavy vertical lines and above the ruling. In so far as possible, these stations should be opposite those as shown on the plan. The writer usually numbers the stations above the ruling the first thing when he starts a profile, then drops his 0 + 00 down so that it will be the same on the plan and in that way start off opposite.

Indicate datum on the heavy horizontal lines and for every 10′ at each end of the profile; also about the center of the profile if it is long, and at such points as datum changes due to "breaks."

The position of the East and West and the North and South property line profiles will be positioned corresponding to the way you want the profile to be read, i. e.; from North to South or vice versa.

Datum for the two property line profiles should be kept two heavy lines apart so that the cross-sections may be platted with their datum on the intervening line and with their center on the vertical line corresponding to their respective stationing. The cross-sections should be platted running the same way as the profile. By platting the cross-sections as above described, the designer has them before him and conveniently positioned for the laying of a center line grade. Sufficient cross-sections should be platted so that a correct estimate of the quantities may be made without the platting of additional ones.

Ground line at property lines should be platted in heavy free-hand, existing walks should be shown in light dashed lines at elevation of back of walk nearest the property lines and existing curbs in light dotted lines. Where existing curbs or walks are shown, ground line may be omitted.

Any data that will be of interest to the designer in intelligently laying a grade should be shown. These data include the elevations of garage floors if adjoining the street or if close to the street so that a driveway to same will have to be provided; also all data on existing driveways, steps to terraces and porches and warehouse floors, so that provision may be made for ramps to afford access for loading and unloading goods.

Show no official grade on a profile, even if one has previously been established. That is the designer's job.

Make your datum figures fairly heavy; the stationing figures for intersecting streets medium in weight and size. Street names on profile should be the same size and weight as on plan.

Lastly, put on the title. Make it concise, neat and plain. The writer considers it a waste of time to put on elaborate, ornamental titles. Remember, this is a work sheet and not some ornamental scroll for posterity to view with awe. A contractor or an engineer will seldom waste time admiring an elaborate title, but will "cuss to high Heaven" if the figures and data on the plan and profile are not clear and plain.

A good way to ascertain whether your work will be legible on a print is to reverse it, then hold it against a window pane. Any figures that are not clear under this inspection will most certainly not show clearly in a print. Lines and figures on a tracing should look just a little too heavy to make an "artistic" tracing, but they will be much clearer on the print and that is what is used to lay out the job. The writer has seen beautiful, spidery-lined tracings and when the print was made and taken on the job in the sun for a little while everybody on the job "cussed" the draftsman for being too "Scotch" with his ink.

The writer lays no claims to being a finished draftsman, but the above is a friendly tip on some of the "do's and don'ts" regarding profiles which he has picked up in the "School of Hard Knocks," the best and most expensive institution of learning in the world.

Sewage and Refuse Collection Notes

Digestion of Sewage Screenings in Pretoria

Pretoria, South Africa, for years had been disposing of its sewage screenings by burial. The yearly average from the ½ in. bar screen amounts to 70 to 80 cu. ft. per million gallons, or 1660 wet tons per annum including night soil. This required considerable land as well as labor, and digestion was considered.

When screenings are dumped into digestion tanks, much of the material floats to the top and forms a tough, thick mat. To eliminate this, Pretoria tried cutting the screenings and found that the finer the state of division the more intense the bacterial action. Experiments demonstrated that fine screenings mixed with raw sludge and properly seeded reacted more intensely than a correspondingly seeded mixture minus the raw or fresh sludge, presumably because the latter, being easily digestible, acts as a source of energy for the bacteria.

The procedure adopted was as follows: Screenings are raked direct from the screen into a sump, diluted with screened sewage, and passed through a disintegrator, which discharges above the screen so that any material not cut fine enough passes to the distintegrator again. The disintegrated screenings and sewage solids settle together in the sedimentation tank, and the mixture is seeded in the sludge sump before discharge into the digestion tank. This plan has proved perfectly satisfactory.

Moving-Floor Refuse Collection Vehicle

The Borough of Stepney (England) has put into service a vehicle for collecting refuse which is claimed by C. Boden, the public cleansing officer, to have a number of advantages. This vehicle has a floor which can be moved either forward or backward; the sides and floor slope downward at an angle of 15° back of the rear wheels, thus giving a low loading height at the rear; from the rear wheels to the front, a top is continuously in place. A platform is attached to the rear a few inches higher than the curb, which further reduces the loading height to 4 ft. 2 in., while the load depth is 3 ft. 4 in. and the capacity is 15 cu. yd. A vertical partition or "barrier" is attached to the floor.

With the barrier moved forward so as to leave a compartment of convenient size between it and the tail gate, this compartment is loaded from the rear platform. The floor and barrier then are moved backward, compressing the load, and moved forward far enough to leave another loading compartment. This is repeated until the body is loaded.

To discharge, the tail gate is raised and the floor moved backward, completely emptying the body at any rate desired.

Advantages found are: Large capacity with a given lift of refuse barrel; rear loading permits complete filling of the vehicle; compressing the load increases the capacity 25 to 100 percent; there is minimum exposure of the refuse; the body of the vehicle is easily cleaned; the cost of upkeep of floors has compared very favorably with end-dump equipment during nine months of service. (This description was given at a conference, in June of this year, of the Institute of Public Cleansing.)

The compression idea described above was not new, but a device known as a compactor has been in use for at least two years by the City of Portsmouth, England. This consists of a row of parallel bars, serving as a coarse screen, running from front to rear of the collecting vehicle at about mid-depth of the body; and, supported an inch or two above these, a pressure plate curved concave toward the rear, which is forced toward the rear by a ram operated by the driver. Refuse is placed in the vehicle at the front, where ashes and fine material drop through the bar screen; then the pressure plate is forced backward, compressing the coarser material against the rear of the steel body of the vehicle, and is then returned to the front to compress the next load. All loading is done at the front. The curve of the pressure plate moves bulky material to the center from either side.

Corrosion-Resistant Alloy Cast Iron for Sewage Plants

In selecting materials for use in sewerage structures, where they will be brought into contact with either sewage or gases arising from it, the possibility of corrosion should be borne in mind. Sewage may carry considerable acid due to trade waste; and even purely domestic sewage may be slightly acid, and may give off sulphuretted hydrogen gas which will combine with moisture on walls or roof above the liquid. Chlorine gas also may be given off by sewage which has been dosed with it. Some materials are disintegrated by certain alkalies.

Iron and steel are corroded by moisture, and more readily and rapidly by even mildly acid sewage or sewage gases. Several substitutes for use in sewage plants are available, including aluminum, copper, "rustless" steel, monel metal, etc. The makers of monel metal now are furnishing a cast metal, as a substitute for cast-iron, which they call "Ni-Resist," which is moderately priced and can be furnished by well equipped foundaries throughout the country.

This alloy contains about 75% iron, 12.5 to 15% nickel, 5.5 to 7% copper, 2.75 to 3.10% total carbon, and small percentages of chromium, silicon and manganese. Its transverse strength varies from 2,500 to 4,000 lbs. with a deflection of 0.2 to 0.3 inch; tensile strength (in 1¼ inch section) 20,000 to 35,000 lbs. per sq. in.; and Brinell hardness 120 to 200. It is readily machinable when the chromium content is under 3%. It can be welded by the acetylene torch in the same manner as cast-iron.

In tests made at the Cleveland sewage treatment plants for 278 days, exposed to both sewage and the fumes therefrom, it was found more resistant to corrosion than copper and nearly as much so as monel metal—more so in the case of chlorine fumes. Studies are now being made on its resistance to sewage treated with ferric chloride, strong solutions of which are very corrosive. There seems to be an almost complete absence of tubercle formation on "Ni-Resist."

The Editor's Page

To Prevent Further Gas Tax Diversion

The legislatures of forty-four states will meet this coming January. In almost every one of them there will be agitation for further diversions of the gasoline tax and of motor vehicle fees from use for highway construction and maintenance. Highway organizations are prepared to combat the tendency to rob our highway systems of the money for which, after all, there can be no more effective use than for roads. No other allotment of these funds that we know of can afford employment to such a large number of men, contribute so materially toward national recovery, and serve such a large percentage of our industries and citizens.

And the *manner* of spending is important. Putting men at work with a pick, a shovel and a few wheelbarrows accomplishes nothing more than direct relief. But putting the same number of men at work in an effective manner, with proper equipment, using proper materials, and under proper engineering control, can accomplish a great deal. There are still many miles of highways, most especially in the rural areas, where farmers at times cannot reach markets because of mud; where 149,000 one-room schools still exist largely because the road system offers too great a handicap to consolidation; and where great numbers of our rural population need highway work to give them the "cash money" they need to pay taxes, and buy clothing, flour and sugar.

The December issue of PUBLIC WORKS will carry a message to the more than 7,000 legislators of these forty-four states, to highway men and workers everywhere, and to city, county and state officials. This message, in which the highway industry has ably and generously cooperated, will stress the possibilities of soundly planned and executed highway work for the relief of unemployment, for the extension of our highway systems, for needed maintenance, and for national recovery.

Credit to the PWA

There is plenty of criticism of the PWA, and much of it may be merited. Nevertheless, it is the opinion of the editors of this magazine, and many of the leaders of the public works field with whom they have talked, that the money spent by the Public Works Administration has done far more toward achieving national recovery than the much greater sums spent through the CWA and the ERA.

The reason is not far to seek. Despite some restrictions in regard to the utilization of machinery, PWA contractors have generally made use of a reasonable amount of modern equipment, thus keeping at their jobs many thousands of workers in our mills and factories. On the other hand, the CWA and the ERA generally contributed nothing toward national recovery, and provided only an existence for the men engaged in their work.

National recovery will never be accomplished by taking our skilled labor from the pipe factories, the highway equipment manufacturing plants, and the other countless industries that serve the public works field, and putting them at work with a pick and a shovel. They, and the nation at large, will be far better off if we can keep them at work supplying equipment for economical and sound public works projects; and they in turn will give employment to millions of others in mines, mills, transportation and other fields.

A Quarter Century Behind the Times in Sewer Designing

"The sizes of the drains were calculated by determining the drainage areas and subdivisions thereof and using McMath's formula." This is quoted from a recent paper describing sewerage work done last year for a large Atlantic Coast metropolitan sewerage district.

It is surprising to the writer that this formula continues to be used by even a few engineers. It was developed by McMath about fifty years ago, from data that would now be considered totally inadequate, pertaining to a relatively small part of the city of St. Louis. Mr. McMath told the writer that it was purely empirical and that he did not recommend it for or consider it necessarily applicable to any other cities. But it seemed to be the best of the empirical formulas developed for American conditions and was quite generally used.

About forty years ago Emil Knickling proposed what is now known as the rational method. This (slightly modified for practical use) was described at length and recommended in the first edition of "Sewerage," in 1898, and since then has been generally approved and adopted and is now used by the large majority of sewerage engineers in this country, and during the past five years more and more English engineers have recognized it as preferable to any of the empirical formulas.

During the past twenty-five years a number of refinements in the use of the method have been proposed by different engineers, and the special reason for referring to the matter now is the appearance, in the October *Proceedings* of the American Society of Civil Engineers, of a very exhaustive study of the use of the method, made by the former chief engineer of the sewer department of St. Louis and an engineer in that department. If anything would finally eliminate from practice the use of the McMath formula (or any other), it would seem as though this would be accomplished by this publicity given to the fact that its use was abandoned more than twenty-five years ago by the city for which it was specifically developed, and that funds of that city and time of its employees have been devoted to studying values of factors involved in the use of the rational method, and with exceedingly valuable results.

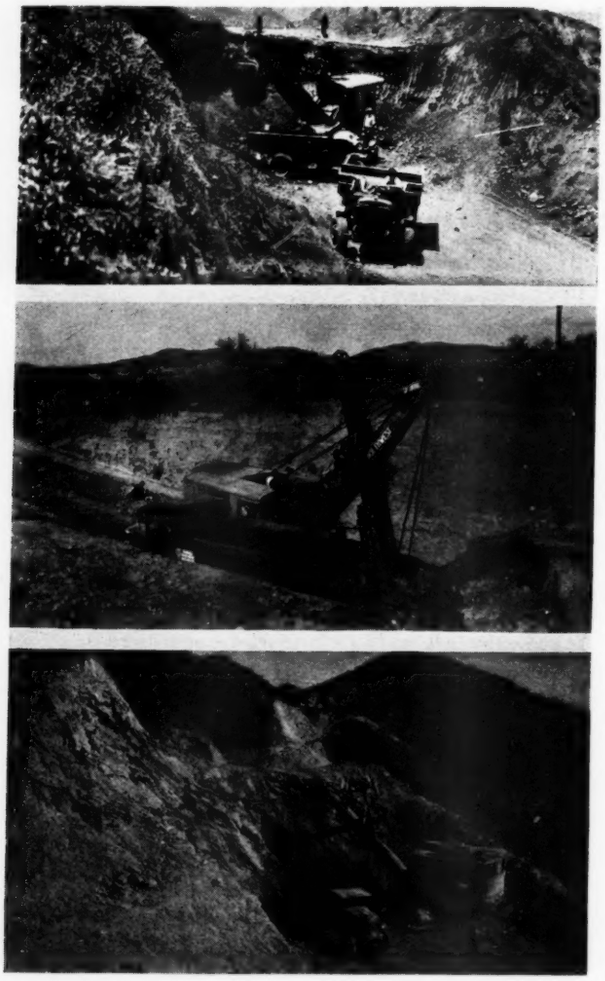
Power Shovel Operation in Highway Grading

By the Bureau of Public Roads, Division of Management. Reported by T. Warren Allen, Chief, and Andrew P. Anderson, Highway Engineer

POWER shovel operation has been studied by the engineers of the Bureau from time to time, with the view of determining and pointing out the delays that increase unit costs in operation. The present study has to do mainly with the operating cycle and factors affecting the rate of production. The report is presented in full with an abundance of data from actual work, in the August "Public Roads," and here in condensed form.

It is shown in the report that in common excavation, with cuts four feet or more in depth, and with material that dumps freely from the bucket, a good operator can load vehicles at the rate of four dipper loads per minute. To attain a 15-second cycle it is necessary to load the dipper regularly in about 5 seconds, to swing it over the wagon in about 4 seconds, to dump it in 1 to 1½ seconds, and return it again to loading position in 4 to 5 seconds. Some of the factors that affect the maintenance of this rate will be discussed.

Character and Material.—Poorly blasted rock, rooty and stumpy soils and tough, moist clays tend to reduce the amount of material that can be handled. Rock must be broken in sizes appropriate for the dipper used, and it is an economy to blast so that there are very few pieces with dimensions much in excess of half the smaller inside dimension of the bucket.



Examples of correct spotting of trucks for loading with short swing of shovel.

Based on a study of more than 20,000 dipper loads handled, the average ¾-yard bucket contained slightly less than half a yard of material, ranging from 0.8 yard in moist to wet clay, down to 0.33 yard in poorly blasted gneiss-granite. Using a 1⅛-yard bucket, results of measurements of more than 15,000 dipper loads showed an average of about 0.58 yard per dipper, ranging from 0.53 yard to 0.63 yard. Studies on about 400,000 dipper loads, using a 1¼-yard bucket, showed loads varying from 0.61 to 1.00 yard. In shallow cuts —which are important factors in dipper loading— and poorly blasted rock, dipper loads averaged just about half the rated bucket capacity.

Time of Loading.—Not only does the presence of difficult material decrease the dipper load, but it increases the time of loading. This is well illustrated by the data in Table 1.

Operating Speed vs. Dipper Load.—The value of making additional passes to obtain a larger dipper load is figured thus: If a ¾-yard shovel is operating in fairly good excavation, in which the average dipper load is 0.5 yard of material as measured in place, and the average operating cycle is 20 seconds, then production is at an average rate of 0.025 cubic yard per second. If six seconds are required to make an extra pass of the dipper, it is not justified unless 0.15 cubic yard can be added to the load. The less the time of loading the dipper as compared to the entire cycle of loading, swinging, dumping and returning, the greater is the importance of getting a full dipper. Consequently it is more important to try for a full dipper when the swing is long than when it is short.

Attempt to increase shovel capacity by using a dipper larger than the shovel is designed for results in lower handling and digging speeds (as well as more time losses due to breakage), and a dipper larger than that for which the shovel was designed is not recommended.

Insufficient Blasting.—There is a tendency among grading contractors to do too little blasting, as well as to slight clearing and grubbing. Poor blasting means the presence of large rocks, and frequently of tight or unbroken ground. Large rocks, tight ground, large roots and stumps slow down shovel operation and there may be additional time losses due to necessity for reblasting or for the removal of large rocks by other means. Poorly blasted material both reduces the amount of material handled by each dipper load, and also decreases the rate at which the shovel can be operated. A case is cited where, in hard caliche a 1-yard shovel could move but 64 cubic yards per hour before blasting, but 151 yards an hour after blasting. The net gain to the contractor, after paying the costs of drilling and blasting, was about 7½ cents per cubic yard in addition to the saving in wear and tear on the shovel.

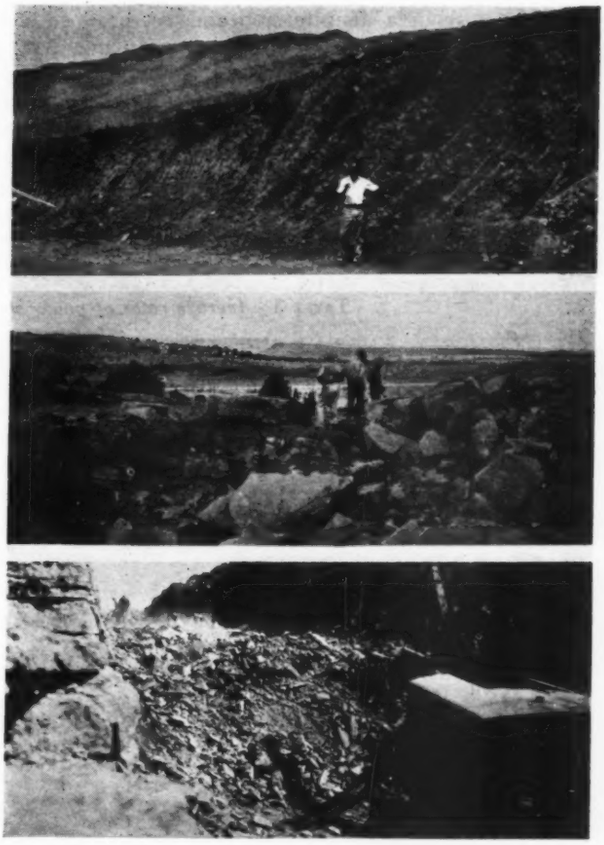
Position of Shovel.—The shovel should stand close to the bank if it is low, with the boom somewhat lower than normal, and must be moved forward frequently. On a high bank, the shovel should stand somewhat back from the bank, so that most of the cutting will be done after the dipper begins to turn upward in its swing.

In very shallow cuts, it is suggested that other methods may be more economical, such as the use of bulldozers and blade graders.

Moving the Shovel.—The time that should be spent in moving the shovel forward varies somewhat inversely as the depth of the cut. Studies made on this factor also indicate the importance of having a shovel in good condition, since the average time, as shown by studies on two shovels, required to move the shovels forward, was only half as great for the shovel in good condition as for the one in poor condition. The moving time is also affected by grade, soft or rough ground, the condition of the moving mechanism, and the ability of the operator. In general, the modern crawler-type shovel can be moved forward in 15 seconds, but with the larger shovels, the time loss required for moving is greater. In deep cuts, the time loss is small—sometimes as little as 1% of the total time used—but in shallow cuts it may amount to as much as 8% to 10%.

There is generally insufficient hauling equipment on a job, and it has often been the custom to consider moving time loss as of no importance, since it has been assumed that it can be done while waiting for hauling equipment. These studies do not bear out this commonly accepted belief. On 14 jobs studied, the 7 jobs with the highest waiting time for hauling units lost 6.1% of their working time while waiting for the shovel to move, while the 7 jobs with the lowest time loss from waiting for hauling units required 3.8% of the working time for moving the shovel.

Angle of Swing.—As a general average, it can be said that loading behind the shovel (a 180° swing) instead of at the side (90° swing) extends a 15-second loading cycle to 20 seconds, and thereby reduces the attainable rate of output 25%. Extending the average swing to 270° may extend a 15-second loading cycle to 25 seconds. Every effort should be made to keep the average swing from exceeding 90°; and in general, a swing of more than 180° is the result of improper equipment or of faulty operating methods.



Top—Material too hard to dig without blasting. Middle—Improper spacing and loading of drill holes; material difficult to load. Bottom—Same ledge as above but properly blasted.

TABLE 1—*Effect of character of material on time required to load and dump dipper*

Character of material	*Observations Number*	*Time to dump dipper Seconds*	*Time to load dipper Seconds*
Loam and light clay	722	1.0	4.2
Do.	351	1.5	5.4
Loamy clay and soft shale	254	1.9	5.4
Soft shale	399	4.2	6.5
Sandy clay	249	3.0	7.4
Moist clay	96	2.4	8.0
Light clay, wet and gummy	173	4.6	8.1
Clay and surface loam	692	1.9	8.4
Sandy clay, moist to wet	349	4.8	8.8
Well blasted sandstone with 20% light clay	229	1.8	9.3
Clay with a few boulders	448	2.1	10.0
Heavy clay, wet and gummy	271	5.3	10.4
Clay with some surface boulders	2,892	1.8	10.5
Loam with loose rock and loose shale	369	2.8	10.5
Do.	288	2.4	11.8
Clay-gravel	506	1.7	11.8
Heavy clay, wet and sticky	83	6.0	12.0
Seventy-five per cent loose shale with 25% clay	579	3.2	12.4
Heavy clay with a few boulders	101	2.0	12.5
Wet clay with some stumps	105	3.2	12.8
Loam with 30% loose rock	148	2.1	13.5
Rock, well blasted	183	3.4	13.9
Do.	560	4.2	15.1
Hard shale, well blasted	1,434	2.6	16.4
Gneiss, poorly blasted	550	10.7	18.5
Fifty per cent loose rock with 50% unblasted shale rock	338	...	28.0

TABLE 2—*Comparison of combined swing and return time for various types of power shovels*

[Values are averages from a large number of field studies under actual operating conditions]

Angle of swing	Shovels No. 1 *Seconds*	No. 2 *Seconds*	No. 3 *Seconds*	No. 4 *Seconds*
30°	8.2	8.0	8.2	5.7
60°	10.4	9.0	9.9	8.4
90°	12.5	10.0	11.5	11.2
120°	14.6	11.0	13.2	13.9
180°	19.0	12.9	16.5	19.3
240°	23.4	14.9	19.8	24.8
270°	25.5	15.9	21.5	27.5

Dumping the Dipper Load.—Roots, tree stumps and large rocks materially increase the time required to dump the dipper. A good operator is a big asset in speed of dumping, which involves spotting and proper elevation of the dipper. Under good conditions, with a free-dumping material, the time for emptying the dipper should not exceed 1 second.

Hauling Equipment.—Both the largest and the most frequent time losses were caused, on the jobs studied, by an inadequate supply of or poor operation of the hauling equipment, or both. For the highest possible production, hauling vehicles must be exchanged within the time required to handle 1 dipper load, or in about 15 to 18 seconds, in good common excavation. An exact 15 to 18 seconds, in good common excavation.

Fine Grading Generally Unprofitable.—Trimming to grade and dressing slopes were prolific causes of extending the time per dipper load. On the average job, the hauling units and the equipment on the dump are entirely unproductive when the shovel is dressing or trimming slopes. Special equipment or hand labor should be used for such work.

Major and Minor Time Losses.—If an operator working on a 20-second cycle slows up just enough to add 1 second to each of the major operations (load, swing, dump and return) the output will be cut from 3 to 2½ dippers per minute. Definite stops are obvious time losses and every contractor makes every effort to reduce them, but a shovel outfit may operate steadily

all day, without a definite stop and yet produce less than half the yardage it is capable of producing. Average major time losses (delays of 15 minutes or more) on more than 100 jobs were 30.1% of the available time; but minor time losses on more than 100 jobs amounted to 38.8% of the actual working time. These included losses due to insufficient hauling equipment; improper operation of hauling equipment; moving shovel within cuts; handling large rocks, boulders, etc.; minor shovel repairs and adjustments; taking on fuel and water; blasting boulders; checking grade, etc.

Care of Equipment.—Routine greasing and lubrication, proper minor repairs and adjustments, maintenance and general overhauling at the time of storing, so as to prevent deterioration, are also very important factors. It has been shown that the time losses for shovels in poor condition are much more than for shovels in good condition; proper storage and protection of the equipment during idle periods is one of the most important of the sources of profits.

TABLE 3—*Average rates of power-shovel operation as observed on typical jobs*

Job number	1	2	3	4	5	6	7	8	9	10	11	12	13
Size of shovel, cubic yards	1¼	1¼	1¼	1¼	1½	1½	1¼	1¼	1¼	1¼	1¼	1¼	1¼
Condition of shovel	New	Very Good	New	Fair	Very good	Very good	New	Good	Very good	Good	Good	Good	Good
Shovel cycle:								7.5	7.0	7.4	8.3	5.6	9.0
Load, seconds	11.5	16.7	11.0	9.6	7.1	8.5	7.9	4.1	3.5	4.9	5.1	4.7	4.7
Swing, seconds	6.0	8.6	6.8	7.6	5.9	8.0	4.9	1.5	1.3	1.1	1.3	1.0	1.8
Dump, seconds	2.0	3.5	1.6	1.7	1.6	1.6	1.0	4.5	4.3	5.2	5.1	4.6	5.7
Return, seconds	6.6	9.1	7.3	8.2	6.2	7.9	4.7	17.6	16.1	18.6	19.8	15.9	21.2
Average shovel cycle, seconds	26.1	37.9	26.7	27.1	20.8	26.0	18.5						
Average angle of swing, degrees	85	130	129	138	103	136	111	96	83	47	76	50	63
Average load per dipper, cubic yards	0.88	0.61	0.68	0.62	0.70	0.85	0.74	0.80	0.87	0.88	1.00	0.96	0.99
Average rate of production, cubic yards per working hour	71.4	38.0	42.8	69.0	97.0	98.0	128	128	150	130	133	168	110
Time lost in moving shovel, percentage of working time	7.2	5.2	7.0	1.7	3.3	4.8	2.1	3.4	5.4	3.9	6.1	9.9	5.5
Total minor time losses, including all stops of less than 15 minutes in duration, percentage of working time	41.2	35.5	54.0	14.8	20.1	17.6	13.4	22.1	23.3	25.0	25.2	23.1	34.4
Total major time losses, including all stops of 15 minutes or more in duration, percentage of available time	21.0	15.5	33.9	12.9	13.8	16.1	11.0	5.7	10.9	8.4	6.1	11.0	11.0
Total yardage moved during study, cubic yards	8,900	2,800	5,950	24,560	20,900	45,680	65,420	62,650	50,400	8,036	18,060	104,680	14,700

1—Earth and poorly blasted rock. 2—Poorly blasted granite. 3—Earth with many boulders. 4 and 6—Fairly well blasted rock. 5—Well blasted rock and earth. 7—Soft rock blasted. 8, 9 and 10—Well blasted shale and sandstone. 11—Fair to hard earth. 12—Good earth. 13—Earth with 12 to 18 in. of frost.

Removing snow from line of ditch preparatory to blasting.

Close-up of the shooting of a section of the ditch.

CWA workers removing chunks of earth from the blasted ditch.

Blasting a Ditch in Frozen Ground

Portland, Main, last winter used a part of its CWA funds for draining the Riverside Golf Course—the municipal links, which project included excavating a ditch for removing both surface water and the flow from a number of small springs scattered over the links. As the ground was frozen to considerable depth, digging by hand was impracticable, and blasting was resorted to.

The work was done under the direction of Superintendent Engineer H. Butler, who states that the work was done in this way more cheaply, even under the unfavorable conditions, than it would have cost to dig the ditch by hand when the frost was out of the ground.

As a heavy blanket of snow covered the ground, removing this from the line of the ditch was the first operation. The exact line of the ditch was then staked out, and holes for the dynamite were made three feet deep on two-foot centers. In each hole was placed a stick of ditching dynamite of 50 percent strength, primed with electric blasting caps, and the holes were wired in series to permit shooting a section of the ditch at each shot. There was comparatively little scattering of the material, as the photographs show, and considerable hand labor was required in clearing out the chunks of frozen earth.

Studies in Water Consumption

Figures from the South Atlantic States for 1933-1934

THIS month we give figures of water consumption by months in the seven South Atlantic States, uniform with those for the New England States given in September and for the Pacific States in October.

Differences between climatic and social conditions in the north and south might be expected to be reflected in considerable differences in water consumption. But these figures indicate that the differences are much less than might be expected.

Comparing averages, we find practically the same percentages of services metered, and only 4% difference in average per capita consumption. Both north and south the month of least consumption is February and the next is April. North, the month of maximum consumption is July, south it is June; and the three maximum months north are June, July and August, and south, May, June and August. The minimum in the north is 7.10%, in the south 7.30%. The maximum in the north is 9.15%; in the south, 9.10%. The difference between maximum and minimum is a little greater north than south—2.40% as compared to 1.80%.

However, we find more uniformity in the south in the case of individual cities. There the maximum is 11.71% and the minimum is 5.70%; or, omitting the winter resort cities of Florida, we find 11.29 and 5.77.

Comparison with the Pacific States shows much greater differences. There also the minimum month is February, and maximum is August; but the minimum figure is 5 28% and the maximum is 11.91%. The accompanying table of averages permits ready comparison of these averages:

Average Monthly Consumption (Percentage of Total for the Year) in Three Sections of the Country

	Jan.	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
New England	7.81	7.10	7.89	7.76	8.69	9.08	9.51	9.28	8.53	8.31	7.93	8.11
South Atlantic	7.74	7.30	7.91	7.68	8.95	9.10	8.86	8.93	8.66	8.62	8.16	8.11
Pacific Coast	5.71	5.28	6.56	7.99	8.21	10.28	11.67	11.91	9.87	8.81	7.43	6.28

Monthly Water Consumption, in Percentage of Total Annual Consumption, for Cities of the South Atlantic States

City and State	*Population*	*Percent metered*	*Consumption*	*Jan.*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
Florida															
Jacksonville	135,146		...	**7.32**	**6.76**	7.90	7.46	9.59	9.02	**8.75**	9.29	9.47	8.50	7.94	7.94
Orlando	30,000	100	93	8.36	7.96	9.05	8.14	10.32	**7.98**	**7.40**	7.37	8.02	8.26	8.35	**8.84**
Lakeland	18,554	100	49	8.33	7.58	8.47	8.49	9.44	9.92	7.70	7.22	7.76	8.18	8.17	8.77
Plant City	10,000	95	50	8.95	8.43	9.55	8.23	10.75	8.15	6.74	6.76	6.93	8.20	8.19	9.18
St. Petersburg	40,000	100	58	10.33	10.60	11.71	10.17	8.12	6.40	5.70	5.82	6.19	7.50	8.00	9.40
Georgia															
Griffin	11,000			5.94	6.40	5.77	6.38	7.52	8.38	8.47	10.42	10.82	10.72	10.02	9.15
Thomasville	11,000	100	50	6.72	6.53	7.10	7.09	9.58	10.32	8.82	8.18	9.08	9.75	8.82	7.96
Maryland															
Baltimore	897,100			**7.87**	7.11	7.56	7.40	**8.14**	9.06	9.19	9.54	**8.74**	**8.77**	8.54	8.12
Hagerstown	33,000			**8.39**	**7.39**	8.30	7.94	8.05	8.44	8.98	8.84	8.37	8.74	**8.23**	**8.43**
Wash. Surb. San. Dist.	65,000			7.94	7.32	8.05	8.06	8.79	9.27	9.92	9.21	8.03	8.07	7.62	7.68
Cumberland	40,000	56	132	8.46	7.35	8.10	8.53	8.29	7.95	8.90	9.20	8.27	8.73	8.13	8.08
North Carolina															
Monroe	6,100			**7.55**	**7.90**	8.31	7.73	8.44	8.55	9.16	9.21	8.29	9.53	7.45	7.90
Rocky Mount	25,000			7.03	7.29	9.52	8.99	8.31	9.19	8.84	8.85	8.08	8.40	7.92	7.60
Shelby	12,000			7.60	**6.66**	7.09	6.98	8.24	9.89	9.68	9.43	9.07	8.75	8.68	8.13
Gastonia	22,000	100	65	7.41	6.62	7.12	6.86	8.26	10.57	10.21	10.04	9.30	8.66	7.61	7.31
Lexington	9,652	100	58	7.74	7.19	7.17	7.30	8.63	9.49	9.96	9.73	8.33	8.39	7.95	8.12
Raleigh	40,000	87	67	8.17	7.34	8.01	7.85	8.86	9.26	9.21	8.58	8.38	8.47	8.06	7.78
Troy				6.47	6.29	6.84	7.48	8.13	8.70	8.57	9.13	10.62	9.45	9.40	8.87
South Carolina															
Charleston	63,000	100	62	8.29	7.36	8.00	7.86	9.15	8.49	8.34	8.70	8.58	8.76	8.05	8.34
Cheraw	3,800	100	50	7.37	7.37	8.11	8.11	8.11	8.85	8.85	9.59	9.29	8.85	8.11	7.37
Spartanburg	35,000	100	93	8.26	7.50	8.11	7.76	9.58	11.29	9.42	8.20	7.59	7.82	7.22	7.25
Virginia															
Fredericksburg	7,610	3	260	8.17	7.54	**7.60**	**7.43**	8.35	9.39	10.17	9.52	8.83	8.36	7.54	7.08
Martinsville	9,000			7.28	6.81	7.81	7.46	7.92	9.26	9.80	9.52	9.30	8.40	8.29	8.20
Petersburg	30,074	100	50	8.12	7.05	7.62	7.45	8.80	9.34	9.28	9.35	8.65	8.69	7.71	7.94
Lynchburg	40,600	100	83	7.22	6.69	7.73	7.12	8.15	10.31	10.00	9.99	9.75	8.20	7.45	7.35
Newport News	60,000	90	70	8.19	7.31	7.78	7.51	8.43	8.68	8.71	9.27	8.83	8.55	8.42	8.25
West Virginia															
Parkersburg	30,000	100	70	6.94	6.95	6.88	7.10	8.42	10.05	9.53	9.81	9 83	9.25	7.71	7.62
Princeton	8,000	100	30	7.32	7.54	7.82	7.48	8.62	8.79	8.51	9.37	8.31	8.24	9.22	8.77
Welch	5,376			8.22	7.08	7.69	7.38	8.06	9.16	8.63	9.60	8.64	8.74	8.58	8.19
Weston	8,600	100		6.92	7.56	7.06	7.40	**9.70**	**9.80**	**8.87**	8.88	9.05	8.42	8.05	8.30
Averages		81	77	7.74	7.30	7.91	7.68	8.95	9.10	8.86	8.93	8.65	8.62	8.16	8.11
Maximum		100	260	10.33	10.60	11.71	10.17	10.75	11.29	10.21	10.42	10.82	10.72	10.02	9.40
Minimum		3	30	5.94	6.29	5.77	6.38	7.52	6.40	5.70	5.82	6.19	7.50	7.22	7.08

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.

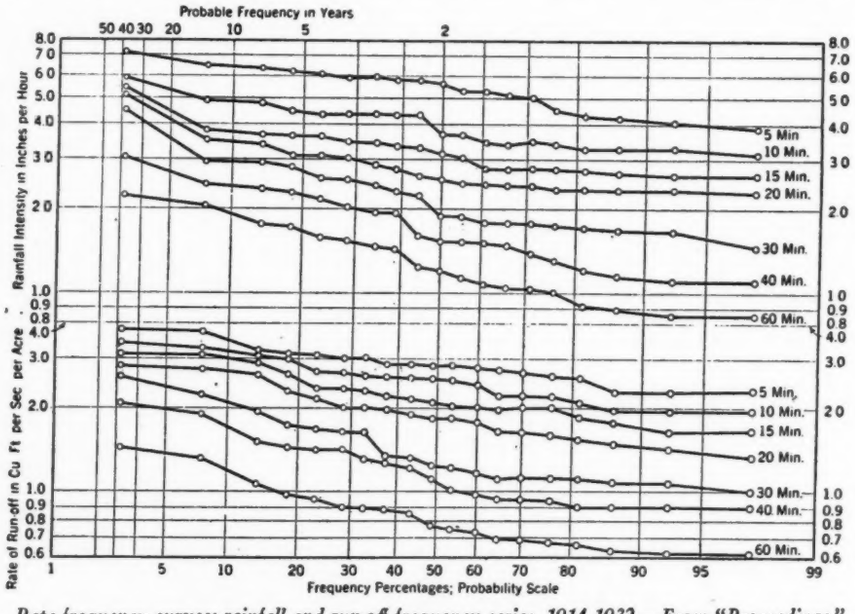
The Digestion Tank

Aerial photograph map was used in designing sewerage interceptors and other improvements for the Annapolis Metropolitan Sewerage District, now nearing completion. There was no general map of the district. "It is believed that use of the aerial mosaic resulted in the expenditure of less money and the securing of more useful data than would have resulted from the preparation of a map based on data collected by surveys made in the field." The Aerotopograph Company took 85 separate photographs and from these prepared a map on the scale of 400 ft. to the inch, six sheets 200 ft. to the inch, and one map 800 ft. to the inch at a cost of $1,463.80. The plans were made on prints from a tracing of the 400 ft. map. The area covered was approximately 3½ by 2¼ miles.[HH10-4]

Run-off to sewers from small urban areas is commonly calculated by the rational method, which involves an estimate, for each class of run-off area, of the percentage of rainfall (especially when approximating maximum rate) which reaches the sewer. A study of this percentage based on data accumulated during 20 years in St. Louis has been presented at length by Horner and Flynt. They obtained values for the ratio P between the volume of water that actually runs off of a given area in a given time and what would have run off if there had been no evaporation or absorption; obtaining such ratios between the totals for a storm and the maximums for a 5-minute or other period. From the latter they conclude that "high rates of run-off are more likely to be the result of a combination of relatively low rainfall rates and high run-off factors than the result of high rates of rainfall." Also "For a given drainage area, the run-off factor P seems to be affected by the season of the year, general climatic conditions, previous precipitation, etc.; but no co-ordination has been determined."

The authors also studied run-off as an independent phenomenon, endeavoring to determine, for each observation station, the answer to the question "How often in a given number of years will a given inlet area discharge storm water at a given rate for a given duration period." Their study was based on run-off data kept continuously for 19 years, 16 years and 12 years, respectively, for three different areas in St. Louis. The curves reproduced in the accompanying illustration "indicate the probable frequency of occurrence of given rates of rainfall and run-off, expressed as a percentage of the total number of events of the same class in a given array."

They find that, in a general way, for flat areas of relatively low percentage of imperviousness, the relation between rainfall and run-off of equal probability does not vary greatly from an average slightly less than 0.4; and for steeper and less permeable areas from an average ratio of about 0.65. For closely built-up blocks the average exceeds 0.8 and the variations are more apparently erratic.[K 11-1]


Probable Frequency in Years
50 40 30 20 10 5 2
Rainfall Intensity in Inches per Hour
Rate of Run-off in Cu Ft per Sec per Acre
5 Min.
10 Min.
15 Min.
20 Min.
30 Min.
40 Min.
60 Min.
Frequency Percentages; Probability Scale
1 5 10 20 30 40 50 60 70 80 90 95 99

Rate frequency curves; rainfall and run-off frequency series, 1914-1932.—From "Proceedings," Am. Soc. of Civil Engineers.

English sewage disposal, as illustrated by 87 plants reporting to Ministry of Health this year, is divided among the several methods as follows: Tanks and filters, 30 plants; tanks, filters and land, 21; tanks, activated sludge and filters, 10; land only, 8; tanks and land, 7; tanks and activated sludge, 4; tanks only, 3; tanks, activated sludge, filters and land, 2; filters only, 1; filters and land, 1.

Dry-weather flow to these plants varied from under 20 gpd per capita in 7 plants to 60 gpd and over in 5 plants; over half of them lying between 20 and 40. Much of the variation is attributed to trade wastes and subsoil water.

Cost of maintaining these plants (taking the pound at $5) varied from under $10 (three plants) to over $50 (thirteen plants) per million gallons; half of them reporting between $10 and $30. Including capital costs, the costs range from under $15 (six plants) to over $90 (eleven plants); 60% of them being about equally distributed between $30 and $75.[D10-1]

Spray-drying of sludge at Plainfield, N. J. (see "Water Wheel" for May) is effected in an octagonal tower 20′ diam. and 40′ high, having at the bottom a furnace room 9.5′ high and above this a drying room 20′ high.[GG8-3] A brick furnace, capacity 400 lb. of soft coal per hour furnishes hot air, which a Buffalo forge fan draws through the drying room at 13,000 cfm. An automatic stoker maintains this air at any temperature between 300° and 900°, and automatic damper

control maintains air leaving drying chamber at any desired temperature between 150° and 250°, which in turn controls the moisture content of the dried sludge. The dried sludge is either burned in the furnace or sold for fertilizer without further treatment. It is inodorous and no tendency to stickiness when moisture content is below 50%; about 25% is desired—if lower, it is difficult to separate sludge from air.

This drying system would not be economical with sludge of more than 90% moisture content. About 25 tons of 90% sludge is reduced to 3.3 tons of 25% sludge at a cost of $3.30 per ton of product—1/3 less if dried sludge be burned. It is estimated that total operating cost will be about $6.50 to $7.00 per ton of dried product. The plant cost a little less than would glass-covered sludge drying beds of equal capacity—40,000 population.

Sludge dewatering experiments by Edmondson and Lumb at Halifax, England, appeared to show[D8-2] that for conditioning for vacuum filtration of mixed humus and activated sludge, and also for filter pressing, the most effective reagents are lime, ferric chloride and ferric sulphate, in the order named. Calcium chloride, aluminum hydrate, caustic soda and sodium sulphate "proved quite ineffective." For vacuum filtration of activated sludge alone, "ferric chloride and ferric sulphate were the most effective coagulants, lime being practically ineffective. To obtain the best filtration, sufficient ferric salt must be added to lower the pH value to 3.0," the amount needed varying, according to the sludge, from 0.5 to 1.0% for chloride, and from 1.0 to 1.5% for sulphate. "The desirability of allowing a contact period of at least a day between the addition of the reagent and the subsequent filtration was also demonstrated." Using cotton twill cloths instead of jute, "for the same quantity of conditioning reagent a much drier product can be obtained from filter presses than by vacuum filtration." Pressing raw humus sludge, 1.25% of lime was the economic optimum, and with digested sludge 1.60%; therefor no advantage in digesting.

Bacterial content of activated sludge was studied by Heukelekian, with a view to utilizing the bacterial count in a practical way as a criterion and index of the condition of the sludge. "The following salient facts seem to be indicated from the results: (1) Cu Cl_2 added to the aerating sludge mixture up to a concentration of 4 ppm had no appreciable effect on the numbers of bacteria but 8 ppm Cu Cl_2 resulted in a definite increase. This was accompanied by a somewhat reduced efficiency of purification. (2) With low concentrations of solids in mixtures of activated sludge, the numbers of bacteria were generally high per unit amount of suspended solids but this relative increase of bacteria was accompanied by a lower purification efficiency. (3) The effect of aerating sludge mixtures of low concentrations is generally an increase in bacterial numbers, while in sludge mixtures of high suspended concentration the bacterial numbers tend to decrease as a result of aeration. (4) Storing activated sludge mixtures without aeration sometimes results in an increase and sometimes in a decrease of numbers of bacteria."[C9-2]

"Adsorption will explain many points of sewage purification technique. Not the air volume, but the mixing of the sewage with the activated sludge, and the detention period, are the decisive factors in sewage purification. The success of the combined process of aeration and paddles, as adopted at Essen-Rellinghausen, rests on the better mixing of the adsorbing flocs with the sewage and its colloids. Similarly, the better purification obtained by activated sluge with an albuminoid sewage as against one consisting mainly of carbo-hydrate matter may be explained by the fact that albuminoid products are almost always present in a colloidal state, and rarely in true solution like the carbo-hydrates. Spode's statement that sewage purification deteriorates below a certain minimum aeration time may be explained by adsorption."[D11-10]

Bibliography

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *t*, technical article.

C 11 *Sewage Works Journal*
September
1. *t.* Vacuum Filtration of Elutriated Sludge. By C. E. Keefer and Herman Kratz, Jr., pp. 845-896, 1,009-1,010.
2. *t.* Effect of Aeration on the Rate of Oxidation of Activated Sludge Mixtures. By H. Heukelekian, pp. 897-907.
3. *t.* Investigation of Rapid Methods for Sludge Solids Estimation. By J. I. Smith, pp. 908-919.
4. *t.* Present Status of Chemicals in Sewage Treatment. By J. H. Brendlen, pp. 920-927.
5. Sewage Treatment in Greenwich, Conn. By Guy E. Griffin, pp. 928-949.
6. Slime Growths in Sewers. By F. E. De Martini, pp. 950-955.
7. Digester Overflow Liquor—Its Character and Effect on Plant Operation. By A. J. Fischer, pp. 956-965.
8. *t.* The Trickling Filter Fly—Its Habits and Control, pp. 966-981.
9. Modernizing Traverse City's Sewage Disposal System. By J. A. Volk, pp. 982-997.
10. Studies of Pollution of New York Harbor and the Hudson River. By Earle B. Phelps, pp. 998-1,008.
11. Purification of Creamery Waste on Filters at Two Iowa Creameries. By W. E. Galligan and Max Levine, pp. 1,015-1,018.
12. Effect of Bottom Ventilation on Purification by an Experimental Trickling Filter. By Max Levine and H. E. Goresline, pp. 1,028-1,030.

D 11 *Surveyor*
September 14
1. Sanitary Problems of the Future. By Allan W. Ritchie, p. 249.
2. Sewage Works Design in South Africa. By M. Lundie, pp. 250-251, 267.
3. Pretoria Sewage Disposal Works Extension. By G. F. Newby, pp. 251-252, 268.

September 21
4. Dewatering of Sewage Sludge by Vacuum Filters. (Hagerstown, Md.), p. 282.
5. Chesterfield Sewage Disposal Works, p. 283.

September 28
6. Significance of Trade Waste Waters in the Purification of Sewage. By H. Möhle (Abstract), pp. 311-312.
7. Sewage and Refuse Disposal at Nuneaton. By R. C. Moon, p. 312.

October 5
8. Sewage Disposal at Motherwell and Wishaw, pp. 331-332.

October 12
9. Clarification of Colliery Waste and Sewage, p. 349.
10. Aeration of Sewage with and without Activated Sludge. By Dr. Friedrich Schmiedt, pp. 361-362.

E 11 *Engineering News-Record*
September 27
1. Sewage Plant Survey, Urbana-Champaign, Ill., p. 404.

October 11
2. Sewage Plant Survey, Baltimore, Md., p. 466.

G 11 *Water Works and Sewerage*
October
1. What Reclamation of Sewage Means to Herington, Kans. By J. E. White and F. M. Veatch, pp. 331-333.
2. Chlorination of Sewage. By Willem Rudolfs, pp. 343-345.
3. Cannery Waste Treatment in Wisconsin. By L. F. Warrick, pp. 346-351.

J 11 *American City*
October
1. Utilization of Gas from Sludge Digestion. By Harrison P. Eddy, p. 11.
2. The Trickling Filter Fly. By Gordon M. Fair, p. 68.

K 11 *Proceedings, Am. Soc. of Civil Engineers*
October
1. Relation Between Rainfall and Run-off from Small Urban Areas. By W. W. Horner and F. L. Flynt, pp. 1135-1178.

M 11 *Canadian Engineer*
October 9
1. Extensive Sewer Construction Program at Ottawa, Ont. By Frank C. Askwith, pp. 12-14.
2. Some Notes on German Sewage Disposal Practice, pp. 15-16.

P 11 *Public Works*
October
1. Most Recent Developments in the Chemical Treatment of Sewage. By M. J. Blew, pp. 12-14.
2. Akron's Sludge as Fertilizer, p. 14.
3. *c.* Vibrated Concrete for Sewers, pp. 15-16.
4. Phenols Removed from Sewage by Compressed Air, p. 18.
5. Salt Water in Sewage Retards Sedimentation, p. 30.
6. Distillery Wastes Disposal, p. 30.

Jacking 68-inch Storm Sewer Under Railroad

By Fred W. Proctor
Superintendent of Streets, Gardner, Mass.

NEARLY 15 years ago, when Gardner began a hard-surface paving program, Main Street was surfaced with concrete. A few years later, the side streets intersecting Main Street were surfaced with road oil, making a hard, water proof coating. One of the results of the paving program was of course improved traveling conditions for the general public, but an unlooked-for complication set in when surface water, instead of being absorbed by the earth, began to run along the hard surfaced streets.

Surface drains were built along the streets in the Washington Hill section, causing a rapd run off of water after rainstorms. The only outlet for the water was a 2′x3′ drain under the eight tracks of the Boston & Maine Railroad. The quick run off caused flooded conditions at several industrial plants due to the inability of the 2′ by 3′ outlet to care for the flow. The result was a series of damage suits against the city by most property owners in that section.

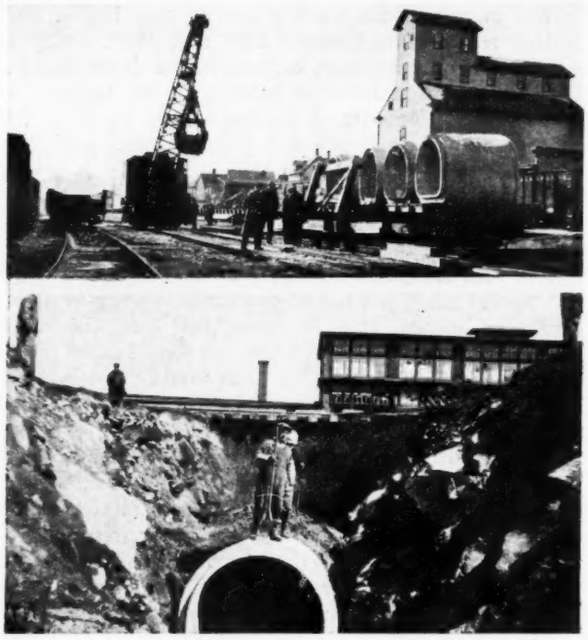
A small fund was eventually set aside for the purpose of constructing a drain on Main Street, but this was diverted late last year for the payment of a strip of paving. As there was no money in the Main Street drain account at the time the CWA program was launched in the country, the city was free to petition for funds for the drain project. The money was appropriated and construction on the drain became a reality.

The city authorities consulted with the Boston & Maine engineers concerning the type of culvert to be used on the project, the outcome being a decision to use Massey 68″x68″ concrete pipe. The jacking method of pushing the pipe underneath the railroad roadbed was decided upon, and work started about Dec. 1.

The roadbed of the railroad at the point where the culvert was to be installed was 144 feet wide, and the flow line was 18 feet below the surface of the roadbed.

The first step in the construction of the culvert was the excavation to a depth of eight feet below the floor of one of the Potter Grain Co. coal pits and the shoring of the buildings. This work took about eight weeks. In the excavation 12″x12″ timbers were placed to form a track for jacking the heavy concrete pipe. A long incline was built from the mouth of the coal shed toward the railroad location, to act as a runway for placing the pipe in position.

The pipe was unloaded by a railroad crane about 300 yards away from the job and was drawn to the job as needed by a 10-ton tractor on hewn skids. Great difficulty was experienced in placing the pipe in position on account of the weight, amounting to nine and one-half tons, and the shortness of the sections, each eight feet long.



Top—Unloading pipe from cars. Bottom—Pipe jacked through and being covered

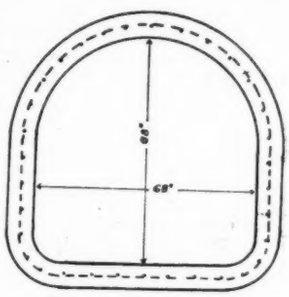
The first pipe was drawn to the location and had to be pushed into the pit with the tractor following down the skids. A track formed of two 3″x12″ planks, placed on the 12″x12″ timbers was provided for the pipe to slide on as runners. The 3″x12″ planks formed a runway for the pipe as it was jacked forward by two 50-ton screw jacks under the railroad.

The second section of pipe was less difficult to place, as it was drawn into position by means of a snatch block hooked onto a heavy timber set across the forward end of the first section, which acted as an anchor. The tractor was utilized for power. The same method was used until four sections were in position, when the combined pressure of four 75-ton screw jacks failed to move the pipe any further into the roadbed.

The two principal reasons for this failure were the extreme cold weather and the reduction in the clearance around the pipe from two inches to less than an inch. Those in charge of operations locally feel sure that if the 2-inch clearance had been used, at least two more sections could have been jacked into place.

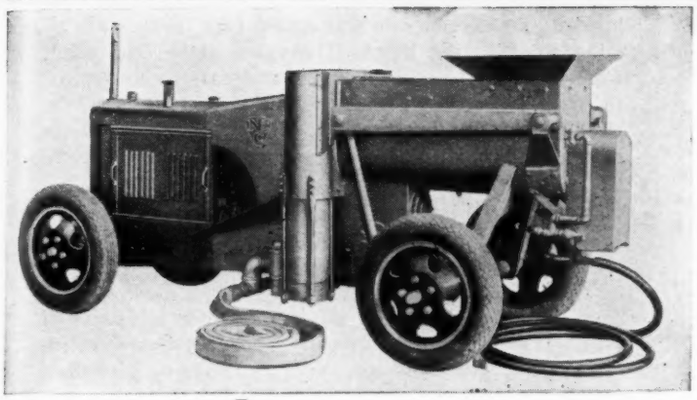
At the time when jacking operations ceased, the pipe had been pushed to the south rail of the east bound main line tracks. The west bound line was in the clear, with a total settlement of less than one inch.

The next operation was the digging of a pit between tracks 3 and 4, used as sidings. The work was done with the aid of a B. & M. Link-Belt clamshell. When completed the pit was 12′ wide, 20′ long, and 20′ feet deep. The pit was completely sheathed with 3″ plank and 12″x12″ rangers, spaced four feet apart. At the bottom a track formed of 12″x12″ timbers was laid, with 85-pound railroad rails, inverted, placed on top of the timbers, and jacked through to the pipe already in position. There was an error of closure of only two inches in alignment of the installed pipe and the rail.

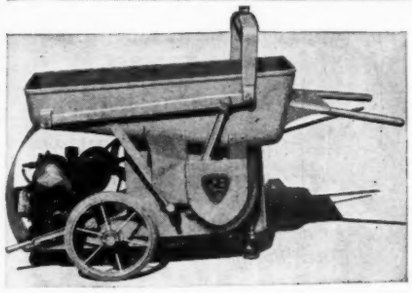


Section of sewer used

MUD-JACK METHOD



No. 50 N. E. C. Mud-Jack for Highway and Extensive Slab Area.



No. 10 N. E. C. Mud-Jack for curb, gutter, sidewalk and streets.

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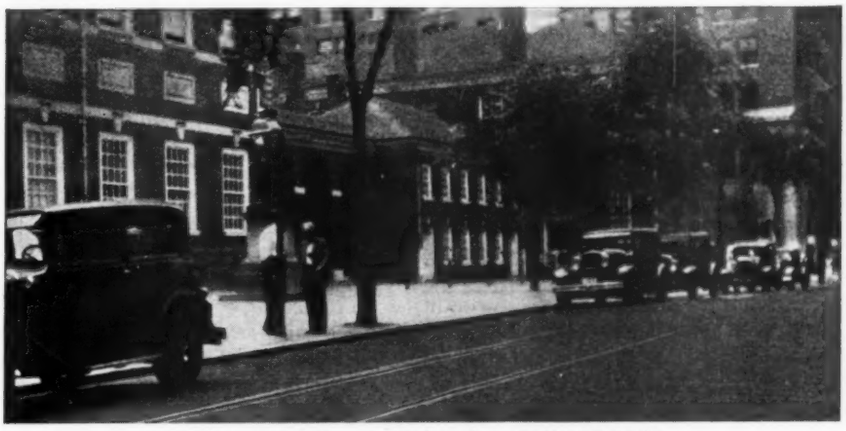

The New Brick Pavement, Independence Hall, Philadelphia

Chestnut and Walnut Streets, Philadelphia, have recently been paved with brick. Thus Independence Hall, America's most historic spot, now faces on a fine brick pavement.

It is especially fitting that the country's greatest shrine should be improved with the world's most enduring pavement.

A newspaper comment, made during the construction of the pavement, aptly summarizes much paving wisdom. It reads in part:

"That new brick paving in Chestnut Street—how well it looks and how easy it rides! Everyone seems pleased with it, and a bit proud. Pleased with its appearance, and proud of such a thorough job. . . .

" 'That's the way the city should do everything,' said an onlooker. 'No big municipality should be content with half-wayness. Makeshift makes for shiftlessness.' " . . .

No other pavement approaches brick in long life and low maintenance. It resists *both* weather and traffic.

For information on brick pavements, write National Paving Brick Association, National Press Building, Washington, D. C.

PAVE AND RESURFACE WITH BRICK

When you need catalogs—consult the *classified* READERS' SERVICE DEPT., pages 55-57.

The inverted rails were heavily greased, and channel irons were placed on each rail. The pipe was lowered onto the channel irons by a crane. The sheathing at the north end of the pit was cut out to permit the entry of the pipe. When the jacking process began, it was found that a single 50-ton jack easily sufficed to move the section of pipe along the rails and through the earth to meet the end of the pipe already installed, leading to the conclusion that the new method was a decided improvement over the skidding method formerly used. Two sections were jacked in a northerly direction from the pit, to meet the pipe which had been jacked southerly from the original starting point.

Two sections were laid in the pit itself, after which it was covered. The remainder of the culvert was laid in an open cut made from the pit to the south edge of the railroad property. The railroad clamshell was used in digging the cut.

One of the interesting features connected with the construction of the culvert was that the railroad did not find it necessary at any time to use a slow board to cut down the speed of trains passing the job.

The work for the greater part was slow and tedious. A maximum of four men was used in the shaft and open cut, while nine men were used in the first jacking operations.

At the north end of the tunnel, 600 feet of reinforced concrete culvert, of the box type, five feet by six feet, was constructed, and at the end of the box culvert 860 feet of 24 inch concrete pipe was laid. The whole project went along every day, Sundays included, employing 48 men, the jacking being on three 8-hour shifts every day.

A central mixing plant was constructed about a quarter of a mile distant, where all the materials were located. To the concrete was added four pounds of calcium chloride per batch. The sand, stone and water were all heated before mixing, and carried to the job in small trucks. Concrete was laid every fair day, regardless of temperature conditions. The thermometer registered from 10 to 20 degrees below zero on several days.

Not a single batch of concrete was lost on the entire job, adequate precautions being taken to cover the concrete with straw and tarpaulins.

This job, which was completed April 1, 1934, has been inspected by many engineers from all parts of New England. The equipment used on the project included an air compressor, concrete mixer, a Link-Belt crane and four 75-ton jacks.

The completion of this project has solved one of the biggest problems the city has had in many years.

The total expenses are as follows:

C. W. A. & E. R. A. Labor	$16,077.57
C. W. A. & E. R. A. Materials	6,339.83
Local Labor	954.65
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Chlorides for Treating Icy Pavements

INVESTIGATIONS of the use of calcium chloride and sodium chloride for reducing traffic hazards caused by ice on pavements have been conducted by the State Highway Department of Michigan and the Engineering Department of the District of Columbia, and a study of the effect of these on the pavement material was made by a committee of the Highway Research Board. The result of these and recommendations based upon them were given in a report of that committee, from which the following is quoted:

"The reduction of traffic hazards caused by slippery roadways is one of the important problems demanding the attention of maintenance engineers at the present time and it is essential that a solution be found. The formation of ice on the pavement surfaces constitutes one of the worst and most difficult conditions to combat. It has been the practice of highway maintenance engineers of certain northern states to use calcium or sodium chloride for treatment of icy pavements. These materials are usually added to sand or cinders and the mixture spread upon the travelled surface. They serve to lower the freezing point and embed the abrasive particles in the ice, thus rendering the surface non-skid. Considerable diversity of opinion, however, has existed concerning the most effective manner in which these chlorides should be used, whether or not they damage the surface of concrete pavements, and their relative ability to melt ice.

"The relative ice-melting power of the two chlorides constitutes a measure of their ability to embed sand. In these tests sodium chloride had the greater melting power and therefore the greater potential sand embedment property at temperatures above approximately plus 10°F. Between plus 10°F. and minus 6.5°F. the differences in melting power are slight. Below minus 6.5°F., approximately the eutectic point of sodium chloride, this salt has no melting or sand embedment power, whereas calcium chloride continues to be active down to its eutectic point, minus 58.5°F. Table I

TABLE I

Comparison of Melting Capacities of Calcium and Sodium Chloride

Laboratory Tests

Temperature Deg. F.	*Pounds of Ice Melted Per Pound of Chemicals.*	
	77-80 per cent Flake Calcium Chloride	*Pure Sodium Chloride*
—30° F.	2.9	—
—20	3.2	—
—10	3.5	—
— 6.5	3.7	3.2
0	4.0	3.7
5	4.4	4.1
10	4.8	4.9
15	5.5	6.3
20	6 .8	8.6
25	10.4	14.4
30	31.1	46.3

shows the relative melting capacities of calcium and sodium chloride at various temperatures obtained in these tests.

"Disintegration of concrete which may occur in connection with the treatment of icy pavements with chlorides, is not due to the action of the chlorides, but rather to the repeated freezing and thawing action produced by the treatment.

"Field observations of concrete pavements indicate that: There are comparatively few cases where pavement scaling can be attributed to the use of calcium

DRIVERS with the most conscientious regard for traffic signs sometimes misjudge snow-and-ice conditions on hills, intersections and curves—even when apparently safeguarded with grit materials.

Plain sand or cinders are *not* always a positive non-skid protection. Too often on hard-frozen ice they slide along almost as ineffectually as wheels themselves. But grit materials treated with Calcium Chloride "dig in." Calcium Chloride has a thawing action that forms a pit, or "foothold," for every particle of sand or cinder. Wheels grip. The grit "stays put". . . . Fewer applications are required.

Stock piles of grit materials treated with Calcium Chloride will not freeze. For emergency purposes, Calcium Chloride used alone will quickly remove dangerous ice sheets. . . . It *destroys* the ice.

Whether applied to stock piles or after the grit materials have been spread, Calcium Chloride adds so little to the cost and so much to the effectiveness of ice-control that it is poor policy not to use it. With the constantly growing dangers to life, limb and property, from increasing traffic, even slippery straightaways demand winter protection. Write for literature and other details on ice control with Calcium Chloride. Address any of the following members of the

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CALCIUM CHLORIDE

FOR BETTER ICE CONTROL

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chloride in the treatment of ice. Many pavements where calcium chloride has been used over a period of years in the treatment of ice, show no indications of scaling.

"The Committee believes that the importance of safeguarding life and property on icy pavements far outweighs the minor damage that may be done to the pavements.

Recommendations

"After careful consideration of the results of these investigations, the Committee makes the following recommendations:

"*Use:* If the treatment is to be applied to cement concrete pavements, the use of calcium chloride is recommended.

"In the case of pavements other than cement concrete the Committee has had no information that either calcium or sodium chloride will promote disintegration by freezing and thawing and therefore either of the chemicals may be used, excepting that calcium chloride is preferable at temperatures lower than 6.5°F. below zero.

"*Abrasive Materials:* Cinders are preferable, although coarse sand may be used since it is more generally available.

"*Preparation of Stock Piles:* In treating stock piles to prevent freezing, 25 to 50 pounds of calcium chloride or sodium chloride for each cubic yard of abrasive should be spread over the piles either dry or in solution.

"*Application:* At the time of application, the material should be treated with an additional fifty pounds of flake calcium chloride or sodium chloride per cubic yard. The treated abrasive should be applied at the rate of 1½ to 2 pounds per square yard of pavement surface. Mechanical spreading is preferable to hand work.

"The use of either chemical, without abrasives, for the purpose of removing ice is not recommended for general practice, excepting in cities where abrasives tend to clog drainage systems. In such cases it is desirable to remove the resulting slush from the pavement.

"There is definite information that the presence of sand or cinders on the pavement surface, after the ice has melted, will cause damage to the pavement by grinding action under the wheels of vehicles. It is therefore important not to apply an excess of sand or cinders and to remove any accumulations of such abrasives from the bottoms of grades or other locations where they may collect."

California Experiments in Curing Concrete Pavements in Winter

WHILE cold-weather curing of cement concrete is a problem that does not ordinarily arise in California, it is said, an investigation and test was made last year by the Division of Highways, in which the Construction Department and the Materials Laboratory collaborated. W. H. Mohr represented the laboratory and prepared the report from which the data were taken, while F. A. Read acted as observer for the Construction Department, the work being under the general supervision of district engineer S. V. Cortelyou.

Experimental test sections were constructed in Los Angeles County during February, 1933. These test sections contained 80 cubic feet of concrete and were made up of two slabs, each 4 ft. x 20 ft. x 6 in., each slab containing seven divisions 4 ft. x 2 ft 10 in., a total of fourteen test sections. Each section was cured under different conditions and observed hourly over a five-day period.

Electro-thermocouples of copper and constantan wire were placed in thirteen of the sections and the fourteenth was left exposed in an uncured condition. The ends of the thermocouples were buried about one-fourth inch in the concrete and a Leeds and Northrup potentiometer was used to measure the potential of the thermocouples, the readings being converted into degrees of temperature. Three-inch mercury thermometers were used to measure the internal temperature of the concrete, being imbedded about 2¼ inches in oil wells. The relative humidity was recorded by the use of a sling phychrometer.

Hourly observations of weather, wind, air temperature and humidity were made over a five-day period immediately following the pouring of the slabs.

The lowest temperature recorded was 19 degrees Fahrenheit at 6 a.m. and the highest temperature was 62 degrees Fahrenheit. Had the same temperature range persisted over the 35-day curing period which elapsed before cores were tested, the heat-hours at the time of test would have approximated 30,000 units.

The coverings used to protect the concrete were as follows: 1. Hopcloth, wet. 2. Burlap, 12-ounce, 1 layer, wet. 3. Burlap, two layers, wet. 4. No cure, dry. 5. Earth blanket, 2-inch. wet. 6. Earth blanket, 4-inch, wet. 7. Ponding, wet. 8. Bituminous membrane on surface and subgrade dry. 9. Bituminous membrane, dry. 10. Bituminous membrane, 1-inch earth blanket, dry. 11. Bituminous membrane, plus 1 layer burlap, wet. 12. Impervious paper, Type A, dry. 13. Impervious paper, Type B, dry.

Tests of coverings 1 and 3 were made on 7-sack concrete.

Three cores from all specimens were taken for crushing at 35 days.

Test Observations

Core strengths at 35 days show the following results listed in the order of breaking strengths.

Method of curing	Compressive strength lbs. sq. in.	Per cent
*1. Hopcloth	4,243	106
8. Bituminous membrane on surface and subgrade	3,990	100
*2. Burlap, 12-ounce, 1 layer	3,950	99
6. Earth blanket, 4-inch	3,845	97
9. Bituminous membrane	3,773	95
10. Bituminous membrane, plus 1-inch earth	3,492	88
5. Earth blanket, 2-inch	3,453	87
11. Bituminous membrane, plus 1 layer burlap	3,400	85
7. Ponding	3,286	82
12. Impervious paper, Type A	3,165	79
3. Burlap, 2 layers	3,050	76
13. Impervious paper, Type B	2,977	75
4. No cure	2,351	59

*Tests marked thus * are 7-sack concrete.*

Conclusions

Unsatisfactory concrete will result under any method of curing tried in the above tests where concrete is placed in locations where the temperatures fall below 20 degrees Fahrenheit at any time.

Black curing membranes increase the heat absorbed by the concrete during the daylight hours, and where covered at night with an insulating medium such as dry burlap or dry earth, the heat is retained in the concrete and thus increases its strength.

Ponding or curing with wet burlap prevents the sun's rays from warming the concrete and induces evaporation which lowers the temperature and delays proper curing.

Coagulants Used in Water Purification*

By L. L. Hedgepeth

Manager, Technical Service Dept., Pennsylvania Salt Mfg. Co.

COAGULANTS which are of economic interest to water purification plants in the eastern part of the country comprise sulphate of alumina, ammonia alum, sodium aluminate, copperas, chlorinated copperas, ferric sulphate and ferric chloride.

The Alums

Sulphate of alumina or filter alum is by far the principal coagulant used in water purification, the yearly water works consumption being estimated at 120,000 tons. It is sold in all quantities from a single bag or barrel to carload lots, both packages and in bulk. Both bags and barrels are usually paper lined as a protection against atmospheric moisture. A barrel weighs 400 pounds gross, 376 pounds net, and occupies a space 24 inches square and 29 inches high. Bags weigh 202 pounds gross, 200 pounds net, and occupy a space 15 inches square and 30 inches high.

Ammonia alum is furnished in either lump, egg, ground, or fine crystals and is packed in paper-lined wooden barrels weighing 400 pounds gross, 375 pounds net for the lump form. Kegs holding 100 pounds net each are also commonly used for small consumers, as for swimming pools.

There are two recognized advantages of ammonia alum over filter alum: (a) It is slowly soluble, thus adapting itself admirably to those plants or swimming pools equipped with solution pots connected across venturi tubes. (b) Its ammonium radical is available for chlorine stabilization.

However, compared on the basis of aluminum oxide content its cost is three times that of filter alum and its use, therefore, as a coagulant is confined principally to swimming pools.

Sodium aluminate is an alkaline compound of alumina and caustic soda which is used most effectively on waters which require an alkali with the alum. Its cost per unit of alumina and sodium oxide is not out of line with equivalent weights of these active ingredients in filter alum and soda ash or caustic soda.

In municipal water softening plants it has a potential field not yet realized because of the satisfaction and relatively low cost of lime-soda softening. It has been found particularly efficacious as a secondary coagulant on those waters having an optimum pH in ranges where residual coagulant is likely to be excessive. With waters deficient in natural alkalinity, the alkaline coagulants have a definite place in effective water treatment.

Sodium aluminate is usually shipped in thin steel non-returnable drums of 108 and 425 gross pounds, or net 100 and 400 pounds respectively. The small drum is 15½ inches diameter and 17½ inches high, and the larger one 21 inches diameter and 34½ inches high. One hundred pound moisture-proof burlap bags also are commonly used.

Iron Coagulants

Copperas is a ferrous sulphate of iron of definite crystalline composition. The most suitable grade for water works use is "sugar sulphate," consisting almost entirely of uniform small crystals of the size and dryness of ordinary granulated sugar. It is packaged in 400-pound paper-lined wooden barrels, 200-pound burlap bags, or is shipped in bulk in box car lots.

It is attractive principally because of its lower active ingredient cost, approximately one-half of that of the equivalent water soluble oxide cost of alum. However, effective precipitation is dependent on oxidation to its ferric state with the dissolved oxygen of the water or with chlorine prior to its introduction into the water; and the reactions are dependent on high alkalinity which must be provided by lime or caustic if copperas treatment is to be effective.

Chlorinated copperas, a mixture of 1 part chlorine to 7-8 parts copperas, is very much more effective than copperas alone and the disadvantage of necessary high alkalinity is entirely eliminated. In practice, copperas may be fed from the usual alum dry feeder, dissolved with water, and the resulting copperas solution merged with the discharge solution of a chlorinator.

Using the cylinder carload price of chlorine of 5½ cts. and of the copperas base $1.00, and using the ratio 17.2 to 28.8 of the respective dissolved oxides, the cost of chlorinated copperas per 100 pounds filter alum equivalent becomes $1.03, as compared with the present $1.25 to $1.35 works price on alum.

Ferric chloride is available commercially in three forms—liquid, crystal and anhydrous. The liquid is shipped in rubber-lined tank cars holding 8,000 gal. or approximately 40,000 lb. It can be had in 12-gallon carboys but so shipped is too expensive for this use. The liquid, therefore, is suitable only for those plants which have railroad siding facilities, storage tanks holding one or more car loads of ferric chloride, and favorable freight rates.

The crystal form melts at 98.6° F. and requires 20 hours at room temperature for solution, and is therefore not particularly suitable for water plants.

In the anhydrous form the melting point is 573.8° F. and the material is very deliquescent. It is shipped in non-returnable steel drums with friction top holding 100 pounds each. Its extremely corrosive action on steel in the presence of water makes it necessary that the entire contents of a container be dissolved soon after opening.

Ferric chloride is a positive coagulant producing clean-cut flocculation in economical doses. On the basis of equivalent units of water-soluble metallic hydroxides, one pound of ferric chloride equals 2½ pounds of filter alum. It is being sold in the middle west for approximately $2.00 per 100 pounds of real $FeCl_3$ delivered as a liquor in tank car lots. This is equivalent to alum at 80 cts., whereas the price is $1.25 to $1.35. In Detroit the saving amounts conservatively to $7.00 per ton of alum.

Prechlorination is essential with ferric chloride use in order to insure precipitation of all the iron.

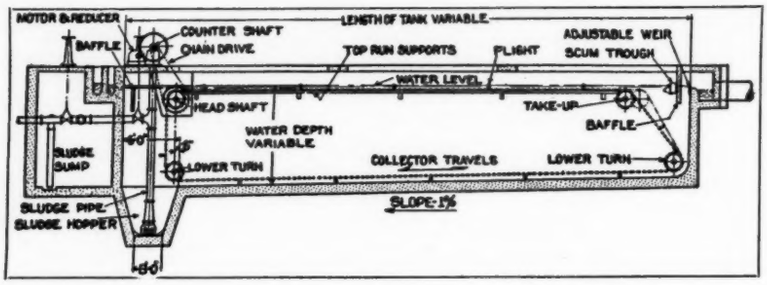
Ferric sulphate is not so corrosive as ferric chloride and may be fed dry from suitable dry feeders. It is shipped in wooden barrels and may be stored indefinitely without difficulty. It is now available from two manufacturers.

*Condensed from a paper before the Virginia Section, A. W. W. A.

[Short Talks with Sewage Plant Engineers]

Believe it or not!

Straightline Collector in Final Tank



Straightline Collector as used in Primary Tank where top run serves also as a scum collector.

Only a few years ago—the accepted plan for removing sludge from a sedimentation tank was to draw or pump off the supernatant liquid and shovel or scrape the sludge into buckets, or shove it along the bottom to an outlet pipe. The improvement of making the tank bottom as a series of hoppers, with a drawoff pipe at the bottom of each, eliminated an exceedingly nasty and tiring job. And when removing the sludge by hydrostatic pressure through pipes placed in the hoppers was intoduced a few years ago, it seemed as though perfection had been reached.

But hoppers seldom clean themselves thoroughly, no matter how steep (within practicable limits) their sides may be; the tanks must be narrow, or the hoppers wide and correspondingly deep; and every foot depth of hopper adds to the cost and carries the excavation that much further into quicksand, rock or water bearing ground. No wonder that construction costs so often far exceed the estimate!

Putrefying sludge clinging to the sides of hoppers is no longer considered permissible; it causes offensive odors and scum, and nullifies all efforts to deliver *fresh* sludge to digestion tanks.

Removal of *all* sludge, at least once a day, mechanically and *inoffensively*, is the only approved modern procedure. *Link-Belt Straightline Sludge Collectors do this with any capacity of tank*, and keep the surface free of scum also. Send for Book No. 642

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Water Light and Power

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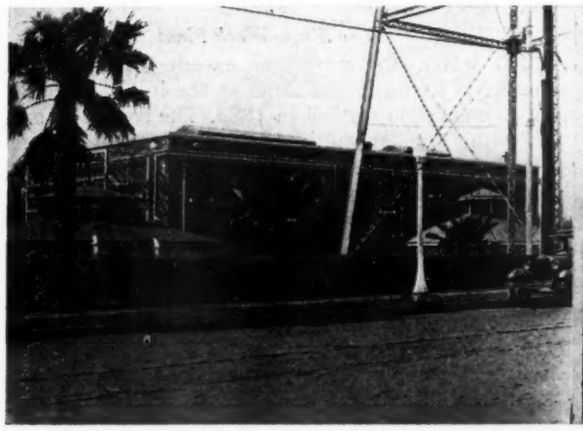
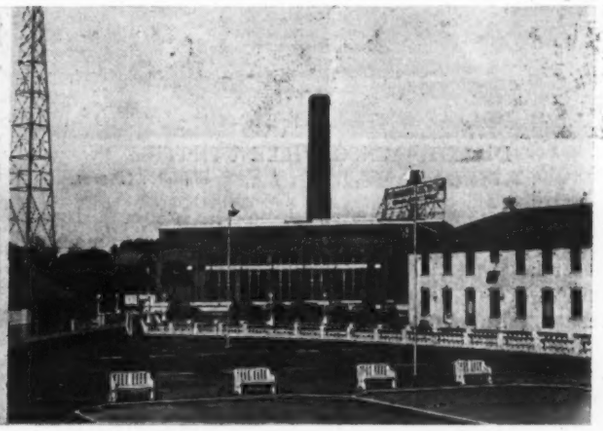


South Jacksonville Sub Station



Main Sub Station and Water Works

Jacksonville's Municipal Water and Light Plants Earned $2,175,762 in 1933

Most of Large Profit Was Turned Into the General Fund of the City

By O. Z. Tyler

Superintendent, Water and Light Department

JACKSONVILLE, the chief commercial and industrial city of Florida, has a population of 135,000, being also the largest city in the state. It is located on both sides of the St. John's river, sixteen miles from the ocean and all but the largest ocean steamships can dock there. The city owns its docking system—the "Municipal Docks and Terminals." The most important industrial plants include railroad shops, fertilizer works, lumber mills, ice plants and naval stores, besides innumerable smaller enterprises.

The city government since 1917 has been of the commission-council form, consisting of a mayor, 5 commissioners and 23 councilmen. Each commissioner is in charge of certain definite activities, one of the five groups being Utilities and Municipal Docks, of which E. E. Anders is at present commissioner and O. Z. Tyler is superintendent.

Joint Operation of Water and Light Plants

The utilities, water and electric light and power, are not only under a single commissioner and superintendent, but the plants are, to a large extent, operated jointly. This permits a number of economies which could never be realized with individual operation. The pumping stations and electric sub-stations are under the same roof, which saves in costs of both buildings and real estate. In two of the sub-stations the pumps are so situated that the switchboard attendant cares for the pumping equipment also, resulting in material saving in labor costs. Use of municipal current for driving the municipal pumps also permits certain adjustments between utilities that effect economy. The synchronous motors used in driving the pumps were selected considerably oversize to permit operating them as synchronous condensers. Reactive K.V.A. is thus obtained at a negligible cost and in sufficient amount to have a considerable influence on the power factor of the system, which is held above 92 per cent at all times.

Although in many ways the two services, water and electric, are operated jointly, the finances are kept entirely separate.

Water Works Finances

On December 31, 1933, the value of the water supply plant was estimated at $3,113,552, of which $1,412,318 was in street mains; $545,777 in wells, conduits and reservoirs, $462,872 in real estate, $359,659 in meters, $152,983 in pumping plant, and the remainder in buildings, fire hydrants, tools, office furniture, etc. Bills receivable of $39,518.00 and cash of $34,914 brought the assets to $3,187,985. The liabilities included $1,155,000 outstanding bonds and $17,642 of bills payable and those not yet due; giving an excess of assets over liabilities of $2,015,343.

The gross earnings for 1933 were $447,219 and the operating expenses were $199,673, leaving net operating earnings of $247,546—nearly 8% on the value of the plant. Of this, $60,575 was paid in interest, $75,000 to the sinking fund, $9,474 sundry charges, and

DIRECT JACKSONVILLE UTILITIES
O. Z Tyler, Supt. *E. E. Anders, Comm.*

the balance was transferred to the general fund.

The earnings comprised $416,501 from commercial water sales, $45,900 for fire hydrant service and $6,653 for sewer and other municipal services; less $21,835 rebates and adjustments.

The total cost of supply and pumping, both operation and maintenance, (including $15,000 for electric power) was $52,618. Operating meters, $27,264, and other distribution operating expenses $20,664. Maintenance of street mains cost $49,796; of meters, $6,151, and of fire hydrants, $42. General expenses, including salaries of officers, clerks, treasurer and engineers, stationery and misc. office, legal, insurance and taxes, was $43,137.

The total expenses, $199,673, for distributing 3,990 million gallons gives a cost of 5 cents per thousand gallons.

Electrical Finances

The value of the electrical plant was estimated at $9,185,270. Additional assets—bills receivable, cash, loans, funds in closed banks, etc.—totaled $498,471, making the total assets $9,683,741.

Against this are $1,387,500 outstanding bonds, and $242,848 bills payable and others not yet due (deposits); giving total liabilities of $1,630,348, and $8,053,393 excess of assets over liabilities.

Although the plant is worth over nine million dollars, the only bonds issued to pay for it were $75,000 in 1893, $27,500 in 1901; $100,000 in 1913, $850,000 in 1923 and $2,000,000 in 1926; a total of $3,052,500; but considerably more than $10,000,000 has been turned over to the general fund for the reduction of taxes; in 1933 alone, $1,820,568 was transferred to the general fund from the electric earnings.

Meanwhile the rates have been the lowest in this section of the country. Those for 110/220 volt residential lighting and cooking are 7c per kwh for the first 35 kwh per month, 5c for the next 40 and 2c for all over 75 kwh, with a minimum charge of $1. The wholesale industrial rate for 2200 volt, 3 phase power is 3c per kwh for the 2500 kwh, 2c for the next 10,000, 1¾c for the next 15,000, 1½c for the next 50,000, and 1¼c for all over 77,500 kwh per month. Some large consumers are served power at 13,200 volts, furnishing their own transformers, and are billed on a maximum demand plus energy used basis which gives a net cost of around 1c per kwh.

The 1933 earnings included $273,272 for street lighting, and $52,426 for other municipal light and power; $2,345,960 for commercial light and power; and $8,733 for current for production and distribution; less $15,398 rebates and adjustments; giving gross earnings of $2,664,993. The operating expenses were $836,776, or 31% of the earnings. The total output was 87,179,700 kw, giving the cost per kw of 0.96c.

The cost figures include $256,506 for operation, and $55,811 for maintenance, a total of $312,317 as cost of manufacture; distribution operating $120,100, distribution maintenance $202,353, and $202,006 general expenses—salaries, office and legal expenses, insurance, care of grounds, interest on deposits and taxes.

The total amount transferred to the general fund, for decreasing taxes, from the two services was $2,082,988, or $15.43 per capita.

The Water Work Plant

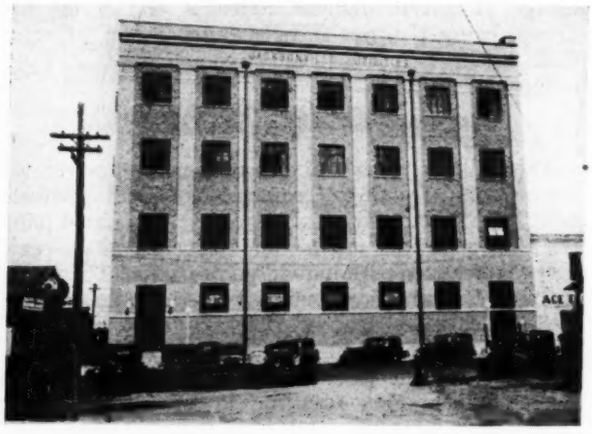
The water supply system, except for size and efficiency, is basically the same as the initial installation which went into service in 1883. The source of supply is flowing artesian wells, which discharge into a concrete aerating reservoir, from which the water is pumped direct into the distribution system. The present four reservoirs are covered, but have screened ventilators to permit surface aeration, and have a combined capacity of 12,000,000 gallons—sufficient for any conceivable emergency.

The water as it comes from the wells is free from sediment or bacteria but contains a small percentage of hydrogen sulphide. Most of this is removed by means of aerators consisting of a series of cypress baffles over which the water flows before entering the reservoirs, the balance disappearing after standing a few hours in the reservoirs. This type of aerator was selected in preference to a spray because the latter, needing a greater head, would require pumping or else result in a decrease in the well flow. Before pumping, the water is chlorinated to destroy any bacteria which might have entered the reservoirs; daily bacterial checks of samples from selected points being taken to assure the effectiveness of this treatment.

There are three pumping stations: Main street, McDuff and Southside. At the Main street station are an Allis-Chalmers 12 mgd reciprocating pump, an Epping Carpenter 12 mgd reciprocating pump and a 6 mgd. electrically driven pump. At McDuff station are two 7.2 mgd electrically driven pumps, one Allis-Chalmers and the other Morris Machine Works. The Southside station supplies an independent system located on the south side of the river—a recent addition to the city not yet connected to the main system. This station contains three small pumps with an aggregate capacity of about 3 mgd. All stations are equipped with Wallace & Tiernan chlorinators.

The distribution system contains 8,054 ft. of 4″ and 5″ pipe; 477,198 ft. of 6″; 208,235 ft. of 8″; 64,298 ft. of 10″; 83,007 of 12″; 4,401 ft. of 14″; 42,834 ft. of 16″; and 10,178 ft. of 20″; a total of 179 miles, all of cast iron bell and spigot with lead joints. In addition

Downtown Laura St., Sub Station and Office



there is 193 miles of temporary galvanized mains, chiefly 1½" and 2".

Of the 28,809 services, 26,207 are metered.

The water pumped in 1933 was 3,990 million gallons. Ten years previous it was 2,904 million gallons.

The Electric Plant

Prior to 1895, when the municipal electric plant began to function, the city was served by the Jacksonville Electric Light Company, which charged 28c per kwh for energy. In 1923 the output of the municipal plant was 46,000,000 kwh with a peak load of 11,000 kw, and in 1933 this had increased to 87,700,000 kwh with a peak load of 22,800 kw. The total capacity of the present plant is 54,500 kw, all in 3 phase, 60 cycle, 13,200 volt G. E. turbo-generators, in units as follows: One 25,000, one 12,500, one 10,000, one 4,000 and two 1,500.

The two largest units operate at 450 lb. steam pressure, and the other, older, units at 200 lb. either from the old 200 lb. boilers or from the 450 lb. boilers through a pressure reducer. Because of the higher efficiencies obtained with the higher pressure, the low-pressure units are operated only during emergencies.

Oil is used as fuel, but provision is made in the newer 450 lb. boilers for using powdered coal should advance in oil costs make this more economical.* At present the output per barrel of oil is approximately 390 kwh, varying somewhat with the Btu of the oil used. The boiler plant consists of ten 500 hp B&W units, 250 lb. per square inch, and three 1500 hp. B&W units, 450 lb. per square inch. The high-pressure units were installed in 1927 along with the 25,000 kw turbine and are equipped with Bailey automatic combustion control. Wheeler condensers are used with both steam and electrically driven auxiliaries. Synchronous motors are used on all electrically driven circulating pumps.

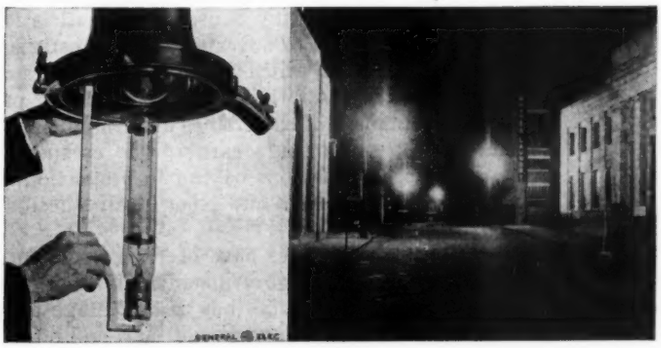
The main switching equipment consists of GE type "H", 3-pole, 15,000-volt, motor operated oil circuit breakers. Each generator is provided with a separate bus from which radiate feeders in proportion to the capacity of the generators. With only one generator on the line, both feeders and generators are connected to a transfer bus. Electrical interlocks prevent the placing of more than 25,000 kw capacity on the transfer bus at one time, as the interrupting capacity of the oil switches is limited to the short circuit current which this connected capacity will give. At capacities above 25,000 kw the generators are paralleled through reactors to a star bus and feed the system through their individual buses.

There are four main attended substations and six unattended automatic substations. All are energized at 13,200 volts and supply the distribution system at 2300 volts. The larger substations are part of a loop system and are equipped with relays which, when trouble occurs within the loop circuit, isolate only that section which includes the fault.

In the downtown area and in portions of the residential areas all circuits, transmission, primary and secondary, are underground, in fibre ducts protected with a 2" coating of concrete. Distribution transformers are in most cases fed at 2300 volts, the secondary voltage for single phase service usually being 110/220, 3 wire.

*The city has just renewed a contract with the Gulf Refining Co. at a price (paid upon delivery) not to exceed 7 cents below the market price per barrel.

High-Intensity Mercury Vapor Lamps Introduced at Lynn, Mass.



G-E Mercury-incandescent Luminaire showing close-up and view of installation in Lynn.

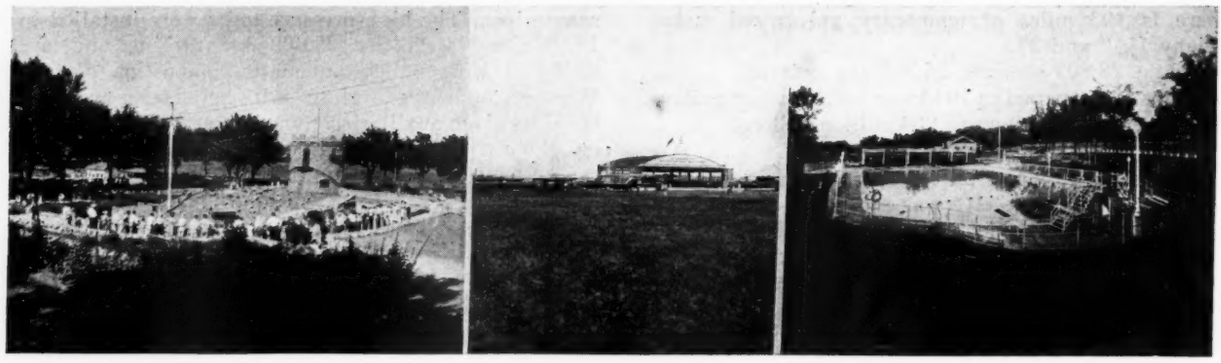
THE first street lighting installation in America incorporating high-intensity mercury vapor lights has been made in front of the new post office at Lynn, Mass., where eight of the units have been put in service by the Lynn Gas & Electric Company. The new units represent a decided advance in the lighting art, incorporating an increase of approximately 50 per cent in the output of light of the complete unit.

The units externally differ none from the usual ornamental street lighting globes. Within, however, are contained two lighting units—one of the new mercury vapor lamps and one of the usual incandescent lamps. The combination of the two types of light emitted by these radically different units, blended within the ornamental fixture, gives a white light that is ideal for heavy traffic thoroughfares and business sections of cities, where white way lighting is generally employed.

The mercury lamp, used by itself, is an efficient producer of bright, slightly bluish green, white light. Its quality is much closer to white than that produced by the low-pressure type of mercury lamp with which the public has been familiar, the light from which is much more bluish. Addition of the incandescent lamp within the fixture contributes a certain amount of yellowish and reddish light, improving the color rendition and more closely approximating daylight. In fact, resultant color changes are no more apparent than with ordinary lighting.

The mercury vapor lamp is rated at 400 watts, and produces 14,000 lumens, or units of light; the incandescent lamp is rated at 200 watts, and produces approximately 3400 lumens. The combination gives 29 lumens per watt, about half again as much light as would be obtained from incandescent lamps alone.

The mercury lamps are manufactured by the General Electric Vapor Lamp Company at Hoboken, N. J., and the lighting fixtures by the Street Lighting Department of the General Electric Company at Lynn, Mass.



Monkey Island *Municipal Airport* *Swimming Pool*

RECENT IMPROVEMENTS BUILT BY THE TAX-FREE CITY OF CHANUTE, KAS.

Advantages of a Tax-Free Municipality

By Ross Cooper
City Clerk, Chanute, Kas.

THE ancient notion that a property tax is necessary to support municipal government has been overcome in Chanute to the extent that all city departments have been operated, since 1930, from earnings of the municipally owned utilities plants.

To approach a tax-free basis, a city must be operating utilities plants that support themselves and at the same time produce surplus earnings. When the utilities begin to make money, the first move is to reduce rates for the services. When the rates are reduced to a reasonably low level, comparing favorably with prices elsewhere, a city may find three answers to the question of disposing of the accumulating profits.

First, the money, far in excess of liberal reserves for contingencies, may remain idle in the treasury, serving no useful purpose.

Second, rates may be reduced to abnormally low levels, based upon cost of production.

Third, the surpluses may be diverted to other city funds, taking the place of property taxes.

The third method, of diverting utilities earnings, is the key by which a city becomes taxless. In Chanute, where city ownership has been developed over a period of forty years, the arguments are conclusively in favor of tax-free government. The property owner benefits, of course. But he is entitled to all the returns that come to him in a taxless city.

Let us compare the property owner of the tax-free city with the owner or stockholder in private industry. In private business, the owner risks his capital on an investment. If the industry is not profitable, or fails, he is a loser. Actually, the distinguishing mark between him and the property owner in a municipal ownership city is slight. The property owner assumed the risk in developing the utilities plants. Had they failed, he would have been subject to higher taxation to cover the loss.

The property owner and the tenant, together, are entitled to reasonably low rates for utilities services. Then, if the plants earn dividends, the property owner who sponsored the development of the municipal enterprises is entitled to benefit through reduced taxes. The tenant also receives a share of benefits in the taxless city. Consider, for instance, the case of the non-resident property owner. He has a saving in taxes, but his benefits are balanced by the advantages he must pass on to the resident tenant. The tenant expects and receives lower rentals and improvements that would not be provided if the owner were paying city taxes.

Freedom from city taxation is a factor that encourages ownership of homes and fosters civic pride. No greater argument could be advanced in favor of a tax-free city.

In a taxless city, everyone who uses electricity, gas and water is contributing toward municipal government. He pays, indirectly, a share of the costs of the city services available to him. We have learned, through careful study, that citizens are paying for these services in proportion to the advantages they expect to receive. Industry uses large quantities of gas, electricity and water in its operation. The wealthy householder's bill is larger because he can afford to buy and operate costly appliances. The chain store, which has no property investment, is a large utilities user. The railroad, a leading patron of the water plant, still contributes to the municipal government. The small wage earner, who escapes state, county and school taxes, is paying in proportion to his ability for the protection and other advantages offered him by his city.

General property taxes have been the chief form of revenue of the various governmental divisions. We all know that the property tax has disadvantages, that it discriminates against the owner of land and other possessions which cannot escape the eyes of the assessor. On the other hand, the taxless city has a new form of revenue. It offers utilities services at rates that are reasonable and obtains sufficient earnings to be applied on fire and police protection and other municipal activities. If this is taxation, it is in a painless form. Who can say that a property tax system, that penalizes land and visible possessions, allowing monetary wealth to escape, is less discriminatory than the method by which the tax-free city derives its revenue?

To the extent that bonded obligations do not interfere with the taxless form of municipal operation, the people of the city favor progressive development that could not be contemplated in a municipality where the costs of improvements are charged up in taxes. Witness the development in Chanute in recent years. The Municipal building, voted by the people, is actually a development of the utilities. Transfers from the plants paid nearly half the cost at the time of construction, and the bonds

(Continued on page 48)

"All projects for water supply financed with the aid of the PWA have been given very thorough scrutiny from the financing, engineering and legal points of view.... As a result, a number of municipalities have been able to sell their securities on more favorable terms than those offered by the government.... It would seem that the analysis made of sound projects by the PWA tends to increase the confidence of private investment houses and the public."

Trends in Water Works Practice Indicated by the Experience of the Past Year

By Paul Hansen

MUCH water works construction now under way undoubtedly would not have been undertaken without the inducement of low interest rates and a grant of approximately 30% of the cost of the undertaking, offered by PWA. On the other hand, allotments made by the PWA were for work that was definitely needed. I have encountered no project financed by the PWA in the field of water supply that was not very much needed and that would not have gone forward in any event in a relatively few years, and I believe this applies universally.

The following tabulation (obtained from published information issued by the Public Works Administration) presents a summary of the water supply projects that have been approved by the PWA, divided as nearly as practicable according to the nature of the project.

Municipal Water Works Projects to Which PWA Funds Have Been Alloted

(From PWA Press Release No. 896)

	No.	*Amount*
For entirely new water works systems....	285	$16,553,810
For source of supply.....	135	24,117,847
For purification and treatment.....	74	11,929,650
For distribution system improvements....	316	38,064,924
For improved storage.....	87	4,138,799
For miscellaneous projects.....	50	2,065,788
Total allotment to August 1, 1934.....	947	$96,870,818
Population connected with all projects.....		17,705,938
Population receiving new water supplies.....		318,025

While there is included a large number of new water works, these are mostly for small communities and hence the total cost and the total population served by these new works are relatively small.

The major item is for improvements to distribution systems. This reflects a general movement to strengthen distribution systems that will be referred to later but also is explainable by the fact that projects for new mains can be more readily prepared than the more complicated projects for purification works, pumping stations, etc.

The large sum covering development of sources of supply reflects lessons learned during the drought of 1930.

Expenditures for purification seem small compared with the attention purification receives from water works engineers and the public. This is in part explainable by the fact that plans for water purification works and accompanying pumping stations are relatively intricate and require much time for their preparation.

All projects for water supply financed with the aid of the PWA have been given very thorough scrutiny from the financing, engineering and legal points of view. In fact, this scrutiny has been much more thorough than ordinarily obtains with usual methods of financing. Many projects have not been approved by the PWA for a number of reasons, principal among which are unsatisfactory financial status of the community and duplication of existing acceptable facilities. The effect of this close scrutiny is reflected in the fact that a number of municipalities have been able to sell their securities on more favorable terms than those offered by the government. As it is seldom that a municipality can finance a public improvement at interest rates under 4% with ordinary methods of financing, it would seem that the analysis made of sound projects by the PWA tends to increase the confidence of private investment houses and the public.

It is difficult to estimate the value of water works construction in relieving the depression. From the above figures it will appear that the total thus far allotted

is much less than the $500,000,000 estimated in 1933 by a Committee of the American Water Works Association as necessary to finance needed water works improvements. To the extent of the money spent, however, water works improvements will promote re-employment both in direct labor and indirectly through the industries which furnish water works materials and equipment, and also through the industries which furnish contractors' equipment.

The various restrictions imposed by the PWA on the selection of labor seem to have had a tendency to reduce the amount of labor employed rather than to increase it. Although contractors are required to use hand labor where practicable, they naturally consult their own interests first and use machinery wherever possible to avoid higher than normal wages and to avoid employing inefficient workmen. Such restrictions, however, affect only the direct labor on the job and do not affect the labor in the contributing industries.

Progress in the improvement of water works practice is so rapid that seldom can any items of progress be identified with a single year. At best it is possible only to indicate trends, some of which may have been active over many years, but which may have become crystalized and definitized but recently. In attempting to outline trends it is likely that some things may be touched upon that do not seem to many as in any way new. However, in reviewing the past year there are a number of items of water works progress that seem to have become more fully accepted.

Sources of Supply

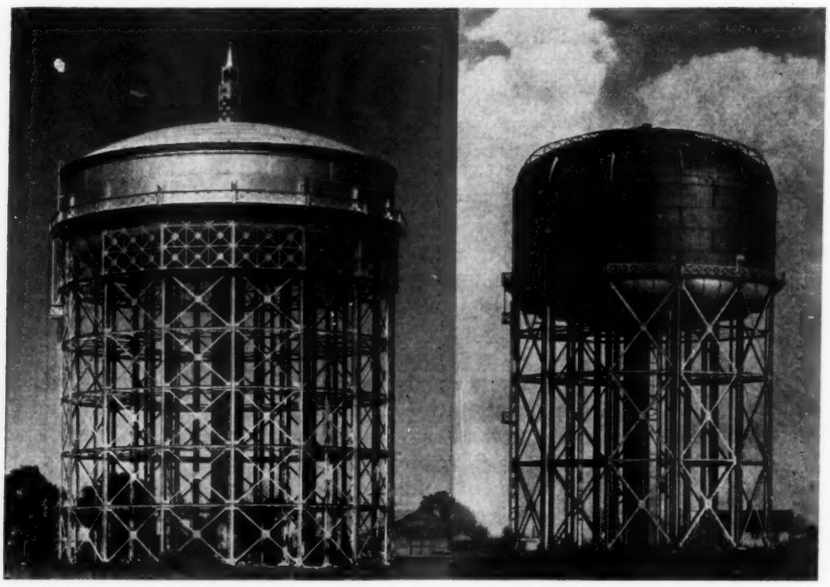
There is a growing recognition that sources of supply must be selected with greater circumspection than was deemed necessary a relatively few years ago. With increasing density of population, increasing volume of domestic sewage, and increasing volume of industrial wastes, even the larger streams and lakes of the country have become so polluted as in many cases to place an undue burden upon water purification works. Notwithstanding the fact that the possibilities of water purification have been greatly increased, the country is alive as it never has been before to the importance of controlling pollution of natural bodies of water, not only to protect public water supplies, but also to preserve natural bodies of water for recreational and other uses. More consideration is also given to securing relatively unpolluted sources of water supply.

This movement has been accelerated by two notably dry years, namely the dry year of 1930 which affected principally the Ohio river valley, and the dry year of 1934 which affected the northwest. During these years many supplies were depleted to the point where communities were obliged to transport water from distant points by rail and truck. Furthermore, the low stream flows concentrated pollution to such an extent that many cities had great difficulty in producing an acceptable and safe water supply. Certain water supplies, notably at Charleston, W. Va., were suspected of being the cause of intestinal disturbances even though they met the requirements of analytical standards, due apparently to the fact that the raw water was excessively polluted, perhaps beyond the capacity of even the most elaborate purification processes to render safe.

Run-off records available during the drought years have placed in the hands of engineers valuable data for the development of adequate water supplies by means of impounding reservoirs. Drought experiences have also called attention to the value and limitations of impounding reservoirs in dry years. If drawn very low they are subject to rather bad tastes and odors due to relatively harmless organisms, but they are nevertheless preferable to water supplies taken from flowing streams in which the concentration of pollution has become great due to low stream flow.

Distribution Systems

There has been no marked change in practice with reference to the development of distribution systems, though certain new influences are making themselves felt. The drought years have emphasized the importance of adequate feeder mains. During these drought years great volumes of water were used for irrigation which taxed distribution systems to the utmost. Weaknesses of distribution systems were thus brought out and many cities in the past few years have developed programs for the strengthening of the distribution systems to meet peak demands. These heavy draughts on distribution systems have also emphasized the value and economy of elevated storage in meeting peak demands and many cities that hitherto have not had elevated storage have adopted it, and others have increased that already in service. Perhaps the most notable case where elevated storage has been adopted is in Detroit. Indianapolis and Evansville, Ind., and Columbus, Ohio, also have recently adopted elevated storage. The feasibility of using elevated storage has been expanded by improved design for large elevated steel tanks.



Evanston tank, capacity 1,500,000 gallons, diameter 104 ft., depth only 25 ft. Height, 117 ft. to high-water line. The required shallowness of the tank was made possible by the radial cone bottom. The ornamental steel work in the top panel of the tower and the cupola were designed by the Evanston Art Commission.

Columbus tank, capacity 2,000,000 gallons, diameter 86 ft., depth 50 ft. Height to high-water line, 125 ft. Part of the ellipsoidal roof is used for tank capacity. The radial cone bottom was used because of the saving in material and cost effected as well as for aesthetic reasons.

The foregoing is the first part of a paper before the American Society of Municipal Engineers. The second part will appear in PUBLIC WORKS for December.

The Power Policy and Rates of the T. V. A.

This article explains where the TVA rates will be applied and is the second in a series on the TVA development.

By W. L. Sturdevant
Director Information Division, Tennessee Valley Authority

THE Tennessee Valley Authority has adopted a power policy which explains where the schedules of rates (which are given at the end of this article) will be applied, and which also serves as a declaration of rights for the citizens of the Tennessee Valley in the use of electricity now and in the future. The power policy follows:

1. The business of generating and distributing electric power is a public business.

2. Private and public interests in the business of power are of different kind and quality, and should not be confused.

3. The interest of the public in the widest possible use of power is superior to any private interest. Where the private interest and this public interest conflict, the public interest must prevail.

4. Where there is a conflict between public interest and private interest in power which can be reconciled without injury to the public interest, such reconciliation should be made.

5. The right of a community to own and operate its own electric plant is undeniable. This is one of the measures which the people may properly take to protect themselves against unreasonable rates. Such a course of action may take the form of acquiring the existing plant or setting up a competing plant, as circumstances may dictate.

6. The fact that action by the Authority may have an adverse economic effect upon a privately owned utility should be a matter for the serious consideration of the Board in framing and executing its power program. But it is not the determining factor. The most important considerations are the furthering of the public interest in making power available at the lowest rate consistent with sound financial policy, and the accomplishment of the social objectives which low-cost power makes possible. The Authority cannot decline to take action solely upon the ground that to do so would injure a privately owned utility.

7. To provide a workable and economic basis of operations, the Authority plans initially to serve certain definite regions, and to develop its program in those areas before going outside.

8. The initial areas selected by the Authority may be roughly described as:

(a) Rural consumers in certain regions immediately proximate to the route of the transmission line between Muscle Shoals and the site of Norris Dam;

(b) The region in proximity to Muscle Shoals, including northern Alabama and northeastern Mississippi;

(c) The region in proximity to Norris dam. On January 4, 1934, the Authority purchased from the Mississippi Power Co. transmission and distribution systems in the counties of Pontotoc, Lee, Itawamba, Union, Benton, Tippah, Prentiss, Tishomingo, and Alcorn in Mississippi. It also made agreements looking to the purchase of transmission lines of the Alabama Power Co. in the counties of Lauderdale, Colbert, Lawrence, Limestone, and parts of Morgan, Franklin, and Cullman in Alabama; and it also made agreements looking to the purchase of transmission lines and distribution systems of the Tennessee Electric Power Co. in the counties of Anderson, Campbell, Morgan, Scott, and part of Claiborne in Tennessee.

At the time of the agreements referred to, the Authority agreed not to construct distribution systems in territory served by the Georgia Power Co. and in the remaining territory of the above three companies. This agreement expires on the completion of Norris Dam, estimated to take less than three years. However, the Authority in the interim may, to the extent of its available power, serve the following additional classes of consumers outside of the ceded territory: (1) Any municipalities not now served by the contracting companies; (2) rural consumers or farm organizations in Rhea, Roane, Meigs, and part of McMinn Counties in Tennessee, and in Monroe County in Mississippi; (3) any customers not now served by the contracting companies up to a total demand of 2,500 kilowatts; (4) any industry operated by the Authority without restriction as to territory.

At a later stage in the development it is contemplated to include, roughly, the drainage area of the Tennessee River in Kentucky, Alabama, Georgia, and North Carolina and that part of Tennessee which lies east of the west margin of the Tennessee drainage area.

To make the area a workable one and a fair measure of public ownership, it should include several cities of substantial size and, ultimately, at least one city of more than a quarter million, within transmission distance, such as Birmingham, Memphis, Atlanta, or Louisville.

While it is the Authority's present intention to develop its power program in the above-described territory before considering going outside, the Authority may go outside the area if there are substantial changes in general conditions, facts, or governmental policy, which would necessarily require a change in this policy of regional development, or if the privately owned utilities in the area do not cooperate in the working out of the program.

Nothing in the procedure here adopted is to be construed in any sense a commitment against extending the Authority's power operations outside the area selected, if the above conditions or the public interest require. Where special considerations exist, justifying the Authority going outside this initial area, the Authority will receive and consider applications based on such special considerations. Among such special considerations would be unreasonably high rates for service, and a failure or absence of public regulation to protect the public interest.

(9) Every effort will be made by the Authority to

avoid the construction of duplicate physical facilities or wasteful competitive practices. Accordingly, where existing lines of privately owned utilities are required to accomplish the Authority's objectives, as outlined above, a genuine effort will be made to purchase such facilities from the private utilities on an equitable basis.

(10) Accounting should show detail of costs and permit of comparison of operations with privately owned plants, to supply a "yardstick" and an incentive to both private and public managers.

(11) The accounts and records of the Authority as they pertain to power will always be open to inspection by the public.

Basic Rates of the TVA

Basic TVA rates for communities, whether urban or rural, do not vary. Any variation will come with a TVA-approved surcharge, such as that which will be imposed in Knoxville to pay back to the Authority the cost of the system. All contracts being made with municipalities contain a provision that recognizes the varying cost of utility operation. The Department of Labor cost of living index is accepted as standard, and when this index shows a decrease or increase greater than 20 per cent, adjustment of rates may be made accordingly, if a written application of such adjustment is approved by the Authority.

Following are the basic Tennessee Valley Authority rates:

Wholesale Power Rates

Wholesale Rate

Demand Charge—$0.90 per K.W. per month

Demand—Maximum integrated sixty (60) minute period

Energy Charge

First	100,000	K.W.H. per mo. at 4	mills per K.W.H.
Next	200,000	K.W.H. per mo. at 3	mills per K.W.H.
Next	700,000	K.W.H. per mo. at 2.5	mills per K.W.H.
Over	1,000,000	K.W.H. per mo. but less than 360 times demand, at 2 mills per K.W.H.	
Excess		K.W.H. per mo. at 1.5	mills per K.W.H.

Minimum Monthly Bill

The minimum bill for any month shall be equal to the demand charge for said month, but in no case less than the charge for sixty per cent (60%) of the highest demand occurring during any month within the previous twelve (12) month period.

Adjustment of Demand Charge

Demand charge may be adjusted if, and when, Authority deems necessary to correct for power factors lower than eighty-five per cent (85%). Such adjustments will be made in such manner as to bring the demand charge to the equivalent of eighty-five per cent (85%) power factor.

Standard Residential Rates

Available

To residential customers for domestic use in single family residences or apartments, at local distribution secondary voltage, either 2-wire or 3-wire service as Contractor may require.

First	50	K.W.H. per mo. at 3c	per K.W.H.
Next	150	K.W.H. per mo. at 2c	per K.W.H.
Next	200	K.W.H. per mo. at 1c	per K.W.H.
Next	1000	K.W.H. per mo. at 0.75c	per K.W.H.
Excess over	1400	K.W.H. per mo. at 0.4c	per K.W.H.

Minimum Monthly Bill

5 Ampere Meter	$0.75
15 Ampere Meter	1.00
50 Ampere Meter	1.50

Basic Commercial Rates

Available

To commercial customers taking service from the Municipality's secondary system.

First	250	K.W.H. per mo. at 3c	per K.W.H.
Next	750	K.W.H. per mo. at 2c	per K.W.H.
Next	1000	K.W.H. per mo. at 1c	per K.W.H.
Excess over	2000	K.W.H. per mo. at 0.8c	per K.W.H.

Minimum Monthly Bill

5 Ampere Meter,	50	K.W.H.	$1.50
15 Ampere Meter,	66⅔	K.W.H.	2.00
50 Ampere Meter,	100	K.W.H.	3.00

Surcharge

Basic Rate subject to a surcharge as provided for in Rules and Regulations.

Basic Industrial Rate

Available

To industrial power users having demands in excess of 10 K.W. Service at primary distribution voltage or secondary distribution voltage at discretion of Contractor.

Demand Charge

$1.00 per K.W. per month.

Demand—Maximum integrated thirty (30) minute period.

Energy Charge

First	10,000	K.W.H. per mo. at 10	mills per K.W.H.
Next	25,000	K.W.H. per mo. at 6	mills per K.W.H.
Next	65,000	K.W.H. per mo. at 4	mills per K.W.H.
Next	400,000	K.W.H. per mo. at 3	mills per K.W.H.
Excess over	500,000	K.W.H. per mo. at 2.5	mills per K.W.H.

Minimum Monthly Bill

$1.00 per K.W. of maximum demand, but in no case shall the maximum demand for billing purposes be taken as less than sixty per cent (60%) of the maximum monthly demand billed during the preceding twelve (12) consecutive months period.

Service taken under the small power rate will be subject to a minimum bill prescribed for commercial customers.

Small Power Rate

Customers having a load of 10 K.W. demand or less to be billed on Basic Commercial Rate.

Surcharge

Basic Rate (including small power rate) subject to surcharge. as provided for in Rules and Regulations.

Seasonal Loads

Contractor may in its discretion discontinue service on seasonal loads and establish a minimum payment for idle months sufficient to cover costs involved.

Developmental Surcharge, provided for in Rules and Regulations:

"Contractor agrees not to depart from the resale rates set forth in the Schedule of Rates and Charges without first securing the consent of Authority: *Provided, however,* that Contractor may apply a prompt payment discount or penalty of not to exceed ten per cent; and *provided, further,* that in order to maintain Contractor's revenues in the developmental period in which the increased demand for power may not compensate for the greatly reduced rates provided for in the Schedule, Contractor may impose a surcharge upon those classes of consumers subject to a surcharge under the provisions of said schedule. Contractor may initially determine and may from time to time vary such surcharge, with the understanding, however, that all revenues over those required for the appropriations set forth shall be applied to the reduction or elimination of surcharges. Surcharges shall be based on a straight percentage of net bills, and shall apply uniformly to all members of classes as to which surcharges are authorized."

Los Angeles W. & P. Dept. Uses "Talkies" to Explain Activities.

To acquaint the public of its community with the new developments and extensions of service being undertaken by the municipal electrical system, the Department of Water and Power of the City of Los Angeles is now completing its second talking motion picture, being produced to order by Metropolitan Industrial Pictures of Hollywood.

The new talking film is "Highlines to Prosperity" which deals with the building of what will be the world's highest voltage long-distance transmission line, extending 270 miles from Boulder Dam to the city of Los Angeles.

Accompanying the film will be a background narrator's voice telling the story of the project and its relation to the domestic and industrial power facilities of the city, with the corresponding influence on industrial development in that community.

The public relations department of the city municipal system keeps many copies of all of its motion pictures in constant use, with showings scheduled practically every day throughout the year before all types of clubs and organizations, churches, schools and other non-theatrical outlets, as well as showings on regular motion picture programs of some forty to fifty local theatres.

Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form

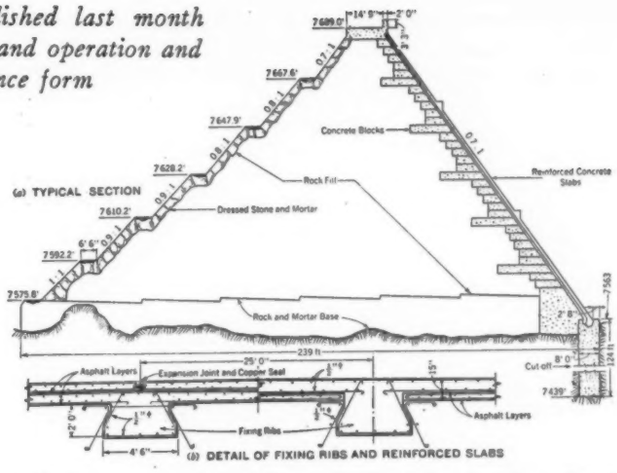
The Water Wheel

WATER sources of supplies furnished to 46% of the population of the United States living in the largest communities are reported by the U. S. Geological Survey, classified in different ways. The supplies covered reach 56.7 million people living in 670 places. The systems of 69 places, with 4.06 million inhabitants, are owned or operated by large holding companies, those of 84 places, with 4.17 million inhabitants, are independently and privately owned. Those in 517 places, with 48.47 million inhabitants, or 85.5% of the total reported, are served by systems owned and operated by municipalities or water supply districts.

The supplies for 450 places, with 47.7 million population, are surface water; for 80 places, with 2.8 million population, are from wells less than 100 ft. deep, infiltration galleries or springs; and for 140 places, with 6.2 million population, from wells more than 100 ft. deep. "The proportion of ground-water supplies to surface-water supplies is undoubtedly much greater for the places not included in the report" (those of smaller population).

The hardness of the water supplied is below 60 ppm for 20.4 million people, from 61 to 120 ppm for 18.5 million, from 121 to 180 ppm for 10.6 million, and above 180 for 7.2 million.[A11-19]

Increasing Aqueduct capacity was necessary as the consumption of Washington, D. C., increased. Two conduits, each 9 mi. long, extended from the intake to Dalecarlia reservoir: one was 9 ft. diameter the other 10 ft. Both have invert slopes of 9 in. per mile. The alternative was building a new conduit. The only method appeared to be increasing the velocity by means of increasing the hydraulic gradient. Raising the inlet head was impracticable because the aqueducts were not designed to withstand internal pressure, so it was decided to lower the level of the water into which they discharged. But it was desirable to raise rather than lower the level of the reservoir so as to increase the head on the filters which received water from the reservoir, and to increase rather than decrease its storage capacity. Therefore 3.5 acres at the upper end of the reservoir was cut off from the rest of it by a dam in which was installed a pumping plant comprising three 75,000 gpm units and one 15,000 gpm. These will raise water from the forebay (into which the conduits discharge), lowering it to El. 140, and discharge it into the reservoir, the elevation of which will be raised to 148. The operation will be fully automatic with supervisory control at the filter plant. This lowering of the forebay is calculated to increase the aqueduct capacity 20%.[HH10-2]



Maximum cross section of Tepuxtepec rock-fill dam.—From "Civil Engineering."

Earthquake-proof dam construction was attempted in the Tepuxtepec dam; also impermeability of a badly fractured foundation, reliable strata being 125 ft. below the stream bed. To accomplish the first, a steep-sloped rock-fill dam was built with a flexible upstream paving of dense, high-strength reinforced concrete. It is assumed that, in case of earthquake, the steep slopes would tend to flatten, the flexible concrete mat adjusting itself to the new slope and substituting a partial failure for a great disaster. The slabs rest on an upstream face of concrete blocks poured directly against the rock fill. There are two slabs of concrete separated by a double layer of asphalt—precast sheets 3 ft. square and ½ in. thick, laid to break joints and reinforced with expanded metal, stuck in place and sealed with hot asphalt. The concrete slabs are tied into the concrete backing by vertical keyways spaced 25 ft. apart.

The concrete cut-off wall is 8 ft. thick, maximum depth 125 ft. To render the foundation impermeable, cement grout was pumped into holes at an average spacing of 15 ft. along the cut-off, some holes taking one sack of cement, others 20 tons at a maximmum pressure of 1500 lb.[L11-1]

Measuring water passing through turbines driving pumps of Calgary water works was effected by "salt titration method. A strong, almost concentrated, solution of salt was pumped into the inlet of the turbine at a certain definite rate; the discharge from the turbine was sampled down stream in the discharge channel, and the discharge computed by multiplying the rate at which the salt solution was fed into the turbines by the ratio of the amount of salt in unit volumes of the primary and secondary solutions. . . . As the salt tests were rather cumbersome they were used only to secure a few points at the conditions which were guaranteed and to calibrate a differential water manometer. . . . A coefficient was obtained from the salt tests which showed that the discharge of the turbines could be read directly from this manometer."[A10-1]

Wood stave pipe, 30" diameter, forming 10¼ mile gravity main for Calgary, constructed in 1907, by 1933 had sustained "fractures due to undermining, decay had set in, particularly at the ends of the staves, and the useful life of the main had drawn to a close."[A10-1]

Glenmore dam, in Calgary's new water system is, for its height, one of the heaviest ever constructed, hav-

ing an area of cross section of 3,000 sq. ft., because situated immediately up stream from a densely populated portion of the city and to give the residents a feeling of security. Its weight is 2½ times the pressure of water standing 9 ft. above the crest plus that of ice calculated at 20,000 lbs. per lineal foot. Friction on the foundation alone would prevent sliding, but a cut-off wall was tied into the body of the dam by reinforcing steel, and the pool wall was keyed 10 ft. into the rock and had behind it an earth embankment 25 ft. high. The most thorough precautions were taken in the concrete construction, and the total leakage from all sources was only 3 gal. per minute.[A10-1]

Chlorine gas leaks are hazards that call for provision of gas masks for emergency use. Detroit keeps a canister-type gas mask outside each of three chlorination stations at its filter plant, in containers hung in a dry place in full view of the operator, in which is a card on which the operator is required to record the date and duration of each use of the mask; and when the service periods of a canister total two hours it must be replaced with a fresh one. Every four months each mask is rigidly inspected for leaks or other defects. "Burrell Industrial" mask used, with GMB canisters, which give protection against acid gases such as chlorine, bromine, hydrogen-sulphide, sulphur dioxide, etc. (There are 11 types of canisters.) The chemical in the canister does not deteriorate by long standing unless in contact with the gas, so should not be hung in the chlorine room. Canister masks protect against relatively low concentrations of chlorine gas only; where the oxygen content of the air is low, a hose gas-mask should be used, and one of these should be kept on hand.[F10-2]

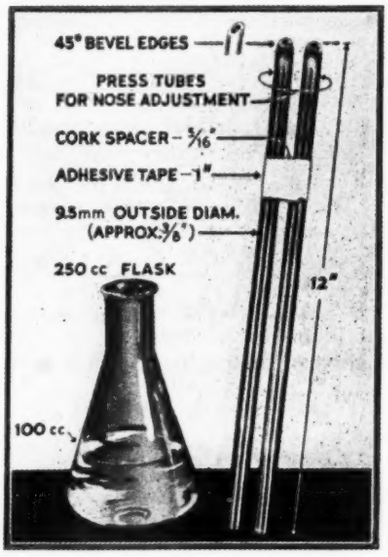
Metering domestic supplies is not generally favored in England, the usual practice being to meter all business use and endeavor to prevent waste in domestic use by constant supervision. In London the water waste prevention division is a most important and effective one. For outside leak detection it uses a hollow bamboo cane fitted with a steel ferrule and a wooden cup at the top against which the ear is placed. It is used like our aquaphone but is considered superior to it.[F11-1]

Water charges in Great Britain are based on the idea "that water is essential for all and that the cost of supplying water to the poor man should be paid in part by his more wealthy brother. The charge is therefore based on the rental of the property and in London is approximately 6% of such rental. If this system were to be applied in New York a residence that is occupied by a middle class family would pay a water rent of about fifty dollars per year as compared with about one-quarter of that amount under our old New York schedule." The London water revenues are about the same as New York's, but the amount of water delivered less than a third as great.[F11-1]

Softening equipment for the lime-soda process is being greatly improved. New types of aerators for removing free CO_2 and oxidizing the iron content; a continuous and automatic lime slaker; new types of mixers for rapidly distributing chemical reagents and for forming a floc; clarifiers for continuous removal of sludge; and improved filter equipment are noted. But there still is great opportunity for improvement in large- scale lime-soda softening.

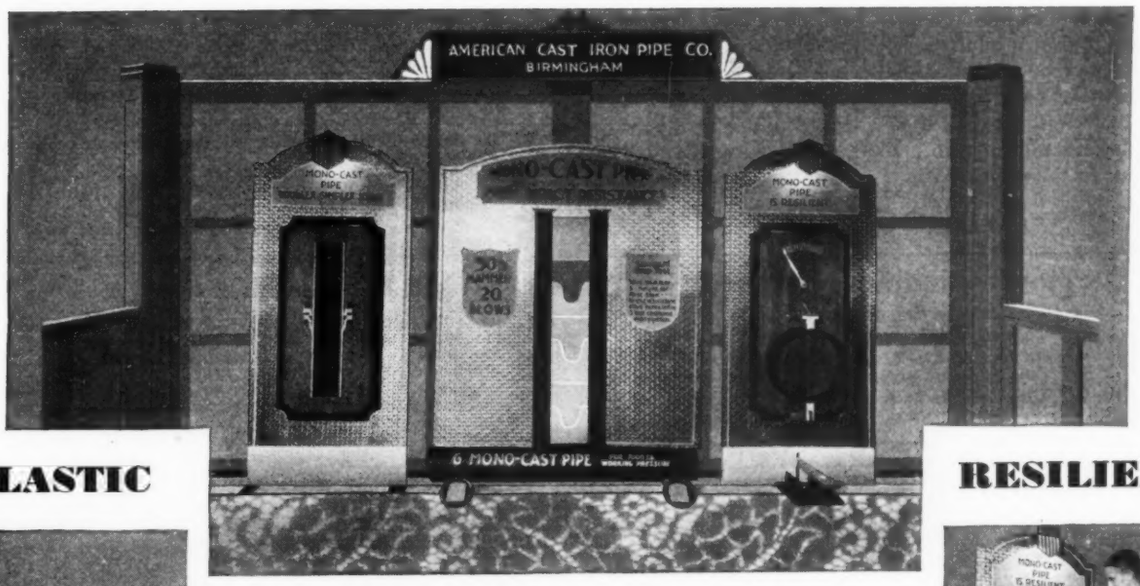
In zeolite softening, iron (if the water contains considerable quantities) should first be removed by aeration, which also raises the pH of the water advantageously. Where turbidity necessitates clarification, the lime-soda process is generally preferable, as it requires little extra equipment. For removing bicarbonate hardness, lime costs only half as much as the salt required for zeolite regeneration; but for removing non-carbonate hardness, the necessary soda ash costs 25% more than the salt required. For a water containing excessive quantities of sodium salts the zeolite process is the more expensive. The zeolite process may be favored by its adaptability to the existing pumping plant, difficulty in disposing of the large amounts of lime-soda sludge, and the simpler operation of the zeolite process.[G10-1]

Porosity of filtering materials affects filter performance—rate of filtration, duration of run etc. Incomplete experiments indicate that the length of runs varies as the 2.13 power of the percentage porosity. Anthracite gave 3 times as long a run as Ottawa sand, crushed quartz 1.5 times as long, crushed glass 2.5 times and Minchar 3.8 times. Baylis has developed the formulas $H = K\,D^{2.15} = \frac{K}{B^{1.5}}$, in which H is filter run in hours, K a filtration constant, D is diameter of the effective size of the material in mm, and B is the rate of filtration in gallons per square foot per minute.[G11-1]

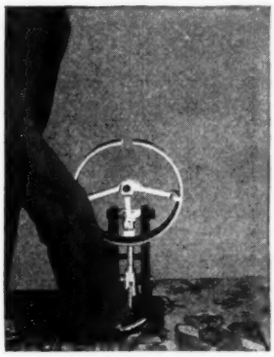


An odor detector developed by F. E. Stuart and shown by the illustration is said to give excellent results and be quite sensitive. The glass tubes are 9.5 mm outside diameter. The beveled edges and holes at the top are made by grinding or filing. To use, put 100 cc of the liquid to be tested in the flask and hold this in the right hand. With the left hand place the tubes to the nose and insert their other ends in the flask within ½ inch of the water surface, and rotate or shake the flask slightly to release the odor.[G11-3]

Ammonia determination by both the direct nesslerization and the distillation procedures as described in "Standard Methods" requires so much apparatus and is so time-consuming that, without modification, it can not be employed conveniently in the field. The use of Nessler tubes is not to be recommended in any case, because of their fragility and the difficulty in packing them. Davis and Kelly have developed "a procedure for the determination of free ammonia which can be used conveniently by plant



ELASTIC



RESILIENT

RESILIENCE *Illustrated!*

Photographs of Acipco Exhibit at the A. G. A. Convention, Atlantic City, week of October 29, 1934

WORDS and formulas fail to give a true picture of what *resilience, elasticity* and *impact resistance* mean in terms of the work a pipe will do and *keep on doing*. That's why we designed the demonstrations shown in the accompanying photographs. The small photograph at the left illustrates *elasticity*: downward pressure on the pedal spreads the split ring (cut from a regular Mono-Cast Pipe); as soon as you release this pressure, the ring springs back into place. The center photograph illustrates *impact resistance*: it is a working model of the "drop test" which in actual practice at Acipco includes dropping a 50-lb. hammer on the pipe through a series of blows, the first blow from a height of 3″ with the height of successive blows increased 3″ each—20 blows for a 6″ pipe designed for 1000 lbs. working pressure. The small photograph at the right illustrates *resilience*: downward pressure on the pedal, magnified many times by a system of levers, causes the ring (cut from a regular Mono-Cast Pipe) to "give"; the amount of "give" is registered by the travel of the needle.

● **So you SEE what we mean when we say that in addition to having high tensile strength "*Mono-Cast Centrifugal Pipe Weathers Shocks and Strains—Both in Handling and in Service*"**

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operators and field engineers. Modifications of the permanent standards given in Standard Methods for the examination of water and sewage have been made for comparison at a depth of 28 millimeters. The accuracy of the method in the presence of usual variations of turbidity or color has been determined and was found to be sufficient for field uses. The procedure is relatively simple and requires no elaborate apparatus." It is described in the paper.[A11-10]

Bibliography

How to find the references

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *t*, technical article.

A — *Journal, American Water Works Association*
11 — *September*
1. Up-to-the-Minute Equipment for Customer Accounting, pp. 1133-1145.
2. Responsibility for Potability of Water Delivered. By L. R. Howson, pp. 1146-1151.
3. Value of an Adequate Supply of Water for Fire Fighting. By Malcolm Pirnie, pp. 1152-1158.
4. Frost Conditions in Canada in 1933-34. By R. H. Martindale, pp. 1159-1173.
5. Operations in the Jacksonville Meter Department. By J. E. Herring, pp. 1174-1177.
6. Distribution System Design and Upkeep. By Rob't A. Duff, pp. 1178-1183.
7. Effect of Meterization on Revenues and Consumption. By E. H. Ruehl, pp. 1184-1188.
8. Methods of Meter Reading, Billing and Collecting. By Hugh B. Rice, pp. 1189-1193.
9. Maps and Records of Existing Water Mains, Valves and Hydrants. By P. H. Johnson, Jr., pp. 1194-1195.
10. Determination of Ammonia in the Field. By W. S. Davis and C. B. Kelly, pp. 1196-1201.
11. Taste Control of Water Supplies. By R. A. Irwin, pp. 1202-1213.
12. Manufacture, Use and Control of Acid at Tampa Water Purification Plant. By J. E. Lyles, pp. 1214-1218.
13. Chemical Control at the Fort Lauderdale Filter Plant. By C. E. Fiveash, pp. 1219-1221.
14. Coagulants Used in Water Purification and Why. By L. L. Hedgepeth, pp. 1222-1233.
15. Effect of Iron in the Determination of Residual Chlorine. By R. D. Scott, pp. 1234-1237.
16. Some Developments in Sanitary Engineering Laboratory Equipment at New York University. By Thos. M. Riddick, pp. 1238-1254.
17. Specifications for Cast Iron Pipe and Special Castings, pp. 1255-1258.
18. Private Well Supplies. By J. A. Bruhn, H. Rupard and N. Kershaw, pp. 1259-1273.
19. Treatment of Public Water Supplies and Their Industrial Use, 1922-1932. By W. D. Collins, W. L. Lamar and E. W. Lohr, pp. 1277-1280.

B — *Journal, New England Water Works Ass'n*
11 — *September*
1. Some Phases of Southern New England Hydrology. (Discussion of March Bibliography 24). By Chas W. Sherman, J. R. Weeks, J. C. Hoyt and J. Glasspoole, pp. 255-271.
2. Reforestation of North Adams Watersheds. By John P. Miller, pp. 272-274.
3. Development of the Manchester, N. H., Water Works. By J. H. Read, pp. 275-280.
4. Manchester's New Distribution Reservoir. By Percy A. Shaw, pp. 281-285.
5. Historical Sketch of the Winchester, Mass., Water Works. By E. C. Sanderson, pp. 286-299.
6. Deterioration of Water Pipes in Belmont, Mass., Resulting from Tuberculation. By Chas. W. Sherman, pp. 300-305.
7. Sanitation of Watersheds. By A. D. Weston, pp. 306-313.
8. Pipe Thawing by Electricity. By H. C. Hamilton, pp. 314-319.
9. Cold Weather Troubles. By P. R. Sanders, G. H. Finneran, W. F. Sullivan and F. H. Kingsbury; with discussion, pp. 320-344.
10. The Corrosion Problem. By Harold C. Chandler, pp. 345-349.
11. Electrical Grounds on Water Pipes. By H. S. Warren, pp. 350-371.

D — *The Surveyor*
11 — *September 28*
1. Underground Water Supplies (British Ass'n Discussion), pp. 305-306.
2. Inland Water Survey. River Flow Gauging, pp. 307-308.

October 12
3. *c.* Construction of the Silent Valley Reservoir, Belfast Water Supply. By Geo. McIldowie, p. 353.

E — *Engineering News-Record*
11 — *September 27*
1. A National Water Policy in the Making. By Carey H. Brown, pp. 393-396.
2. Largest British Dam Completed in India (Mettur dam), pp. 405-406.

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3. New Index Recommended for Filter Efficiency. By Robert Hulbert and Douglas Feben, p. 423.
4. Changed Elevated Tank Design Required for Safety Against Earthquakes. By A. L. Brown, pp. 424-426.

October 11
5. *c.* Cooling Boulder Dam Concrete. By Byram W. Steele, pp. 451-455.

October 18
6. Groundwater in the Midwest Drought Area. By O. E. Meinzer, pp. 495-498.

October 25
7. *c.* Placing 40-Ton Concrete Pipe in Little Morongo Siphon, pp. 526-527.

F — *Water Works Engineering*
11 — *October 3*
1. Water Works Observations Abroad—London. By W. W. Brush, pp. 1102-1104.
2. Developments in Taste Control. By R. A. Irwin, pp. 1108-1110.
3. PWA Results Reviewed at N.E.W.W.A. Convention, pp. 1111-1116.
4. Are Special Rates for Sprinkling Profitable to Water Works? By R. B. Simms, p. 1127.

October 17
5. Operating Results of the Eugene Filter Plant. By F. Ford Northrop, pp. 1150-1153.
6. Painting Fire Hydrants. By Nathan N. Wolpert, pp. 1154-1155.
7. Inserting Gate Valves in Water Mains Under Pressure. By Chas. Streithoff, pp. 1175-1176.
8. Increased Efficiency by Booster Pumping Plant. By J. E. Curtis, p. 1180.

G — *Water Works and Sewerage*
11 — *October*
1. Filtering Materials for Rapid Sand Filters. By John R. Baylis, pp. 352-357.
2. Stirring Apparatus for the Determination of Coagulant Dosages. By Thomas M. Riddick, pp. 358-360.
3. An Inexpensive Odor Detector. By F. E. Stuart, p. 351.

J — *American City*
11 — *October*
1. Making an Emergency Water Waste Survey. By Fred B. Nelson, pp. 45-46.
2. Tastes and Odors in Water Supply Caused by Electric Currents. By M. Warren Cowles, pp. 59-60.
3. Water Rates and Service Charges (in six cities), pp. 87, 89.

K — *Proceedings, Am. Soc. of Civil Engineers*
11 — *October*
1. The Silt Problem (in reservoirs). By J. C. Stevens, pp. 1179-1222.

L — *Civil Engineering*
11 — *October*
1. The Tepuxtepec Rock-Fill Dam. By H. E. M. Stevenson, pp. 524-528.

M — *Canadian Engineer*
11 — *September 25*
1. International Congress on Large Dams, pp. 7-10.

October 9
2. Glenmore Dam and Pumping Plant, Calgary, Alta. By Wm. Gore, pp. 7-11.

P — *Public Works*
11 — *October*
1. *c.* Vibrated Concrete for Dams, Tanks, Etc., pp. 15-16.
2. Studies in Water Consumption: Pacific Municipalities, p. 17.
3. Prevention of Tubercles by Ammonia-Chlorine, p. 29.
4. Seattle Water Dept. Nets $169,379, p. 40.
5. Spiral Welded Pipe for Water Supply, p. 54.

T — *Technique Sanitaire et Municipale*
11 — *August*
1. Pour Avoir de l'Eau dans le Hameaux Isoles, pp. 175-176.
2. Le Filtration des Faux Industrielles par les Filtres Schumacher, pp. 176-177.
3. Un Cas de Pollution d'Une Nappe Aquifere par des Deversements de Produits Chimiques. By G. Grenollleau, pp. 180-181.
4. Les Adductions d'Eau en Italie. By A. Lutrario, pp. 181-183.

Y — *Municipal Review of Canada*
11 — *October*
1. Chemicals That Make Water Safe, pp. 16-18.

EE — *Journal, Maine Water Utilities Ass'n*
11 — *October*
1. Uniform Marking of Fire Hydrants. By J. W. Randlette, pp. 95-97.
2. Metering: Reasons For and Against It. By H. L. Clark, pp. 98-100.

JJ — *Journal, Southeastern Section, A. W. W. A.*
11 — *Year of 1934*
1. Reconstruction of the Riverside Station, Macon, Ga., Water Works. By T. E. P. Woodward, pp. 5-15.
2. Handling and Storing Water Works Chemicals. By L. L. Hedgepeth, pp. 16-30.
3. The Flow of Small Streams. By B. M. Hall, Jr., pp. 31-43.
4. Putting Plan Into Our Future. By H T. McIntosh, pp. 44-50.
5. Underground Corrosion in the Southeastern United States. By K. H. Logan, pp. 51-71.
6. Trends in Stream Pollution Research and Control. By J. K. Hoskins, pp. 72-83.
7. Open vs. Covered Reservoirs. Discussion, pp. 97-98.
8. Carbon Dioxide Removal and Corrosion. Discussion, pp. 99-100.
9. Improved Designs of Elevated Tanks. Discussion, pp. 100-103.
10. Painting Water Works Structures. Discussion, pp. 104-108.
11. Handling Customers' Complaints. Discussion, pp. 108-110.

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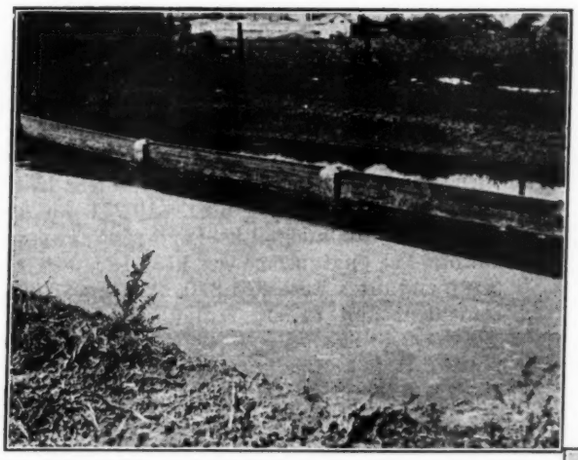

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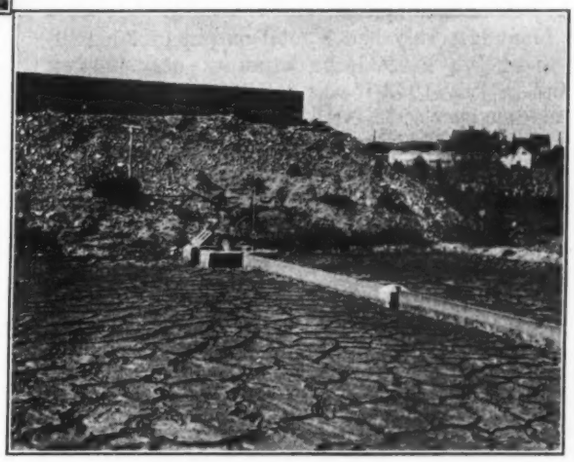
This illustration shows the sludge drawn from the sewage after coagulation with Ferric Chloride. To the right is shown the same sludge after four days' drying on an open sand bed.



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Have You Heard?

Seattle May Acquire Puget Sound Power and Light Co.

In Seattle, Wash. last month J. D. Ross, Superintendent of the municipal light department, proposed that the city acquire the entire system of the Puget Sound Power and Light Co. including all properties of the Puget Sound Co. in Western Washington and at Rock Island in the Columbia River in Eastern Washington.

The price suggested by Mr. Ross is $95,000,000. and the deal would be financed by the issuance of thirty-year City Light utility bonds at 5% interest to be retired solely from earnings of the plants purchased. If the city council adopts the proposal it will be necessary to change the existing law which provides that all revenues of a municipal utility must go into a common fund and that all the utility's debts are against the general system.

At present City Light operates its own system, valued at more than $43,000,000, in competition with the Puget Sound Co. in the city of Seattle. If the Ross plan is adopted, the municipal light department would extend its service throughout the territory now served by the private company. All cities, towns and power districts would then have the privilege of purchasing at cost value parts of the system lying within their own limits. They could either generate current themselves or buy it from the Seattle system or from private companies.

McPherson, Kas., Sets New Record

During the month of July the McPherson Municipal Light department produced the greatest 30 day output in the history of the plant. The July electric output was 11.65 per cent larger than the June figures which set the previous all-time mark.

The plant last July had a total output of 706,980 kwh. During July in 1933, the output was only 434,700 kwh, and in July 1932 it was 269,260 kwh. The July 1934 increase over 1932 is 162.56 per cent, and 62.63 per cent over the 1933 production.

The June output for the year was 633,200 kwh, 73,580 kwh under the July figure.

Asked what he thought was the cause of the enormous increase Supt. L. C. Angevine of the Water and Electric Department said that he believed it was due to the extensive use of electric fans and air conditioning machines that were put into use last month. Heavy refinery operations also aided in the increase.

Holland, Mich., Operates Municipal Compensation Insurance

The Board of Public Works of Holland, Mich., operates an employees' compensation insurance fund, charges being made against the payroll at the same rates which would be paid in premiums to an insurance company. At the end of 1933 there was a cash balance in the fund of $13,689.95.

Since the fund was established, in 1921, there have been 202 accidents to employees, of which 29 were compensable and 3 fatal. The total compensation paid has been $22,030, while $2,411 has been paid for medical services and supplies and $904 for funeral expenses. The total charges against the payroll have been $36,259, and $2,831 has been received as interest.

First aid cabinets are kept in all departments and trucks, and it is the duty of the foreman in charge to keep the cabinets well supplied for any emergency.

Employees are cautioned to have the smallest scratches and wounds treated to prevent infection. First aid classes in charge of competent instructors are held every two weeks, and all employees whose duties are in the least hazardous are required to attend these classes. The latest methods of first aid practice are taught, and the Shafer prone pressure method of artificial respiration is used.

In addition to this, a report must be filed by the foreman in charge as to the condition of safety equipment such as rubber gloves, rubber blankets, insulator hoods, line hose, hot line tools, etc. Equipment not in good order is immediately discarded and replaced with new. The increase in voltage from 2,400 to 4,160 makes it imperative to use extra precautions, especially in case of change-overs where the current cannot be shut off.

Municipal Water and Light at Princeton, Ill.

Princeton, Ill., about 5,000 population, furnishes water, light and a small amount of steam heating municipally, pumping and filtering the water and generating its own current. For the year 1932-'33 its income from sales of water was $29,481; of light, $103,392; and of steam heat, $4,017. These include $6,498 for hydrant rental and other municipal use; $19,271 for street lighting and other municipal use; and $546 for municipal heating. The total income was $138,185.

The expenditures were $61,870. Adding $8,000 as tax equivalent and $1,000 rental, gives a total of $70,870, and a profit of $67,315. The plants are valued at $572,333. If we take interest and depreciation on this at 10%, we have a net profit of $10,082. During the year, capital liabilities were liquidated to the amount of $17,556.

Advantages of a Tax Free Municipality

(Continued from page 46)

are being retired annually from utilities earnings. The $75,000 airport, the $50,000 swimming pool and the Monkey Island are more recent improvements. The cost of all these projects was paid from surplus utilities funds.

The tax-free city offers a saving to the industry in property taxes. At the same time, its concessions in lower utilities rates can be made on the same basis as the offers to industry in other towns served by either municipally or privately owned plants.

The taxless form of operation is a direct brake on extravagance by municipal official. Efficiency in operation and economy in management are essential if the city is to continue without a property tax levy. The public, as well as the official, is fully aware of this fact. Consequently, the official whose laxity or willful acts compelled the city to return to property taxexs would suffer in the hands of the voters. His fate would be political suicide.

Finally, the tax-free town answers the arguments of interests that insist public owned utilities do not pay their share of taxes. In this town, the utilities pay the entire municipal bill that normally is charged to the taxpayers.

EDITOR'S NOTE: Comments of those who do not agree with Mr. Cooper are welcome and will be published in an early issue.

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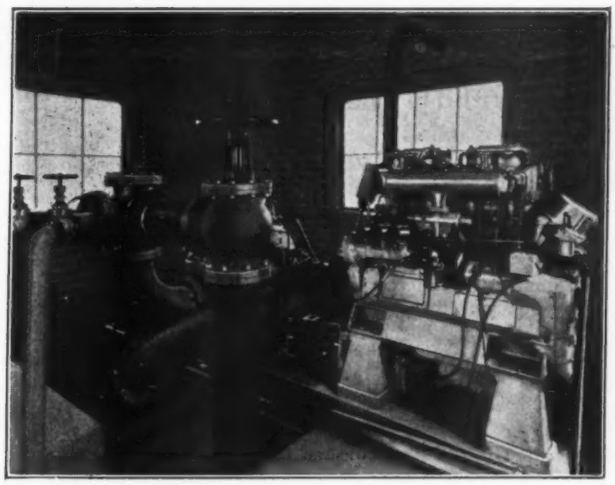

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Water Works Valve—Gasoline Hammer—Insulated Cable
Improved Sedimentation Equipment

No Digging With This Valve:

Jenkins Bros. announces a new water works iron body gate valve with a key-operated stuffing box that can be serviced from the street level without necessitating any digging and repaving of roadway surfaces. This immediately eliminates a major part of the cost attached to the regular inspections of "buried" valves and might permit more frequent inspections which would tend to cut down water losses. The valve is made in two patterns: Double Disc, Parallel Seat type and Solid Wedge type. Both conform to all of the specifications of American Water Works Association.

The accompanying illustration shows how this new key-operated stuffing box works. The key fits over the stuffing box nut and as this is turned down, the stuffing box follower compresses the packing making a tight joint. To prevent corrosion troubles the entire stuffing box assembly is of bronze.

Data on this new valve will be sent on request to Jenkins Bros., 80 White Street, New York City, N. Y.

A Gasoline Hammer:

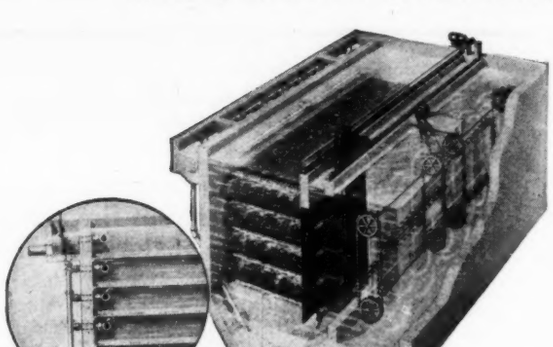
You do not need compressed air with this hammer, which operates by means of a small built-in gasoline engine. For small jobs where a large air compressor and a heavy hammer is not necessary, this unit fills the bill. Excellent for municipal work, for breaking concrete, tamping back-fill, digging in frozen ground, shallow drilling, driving sheet piling, and numberless other jobs. Very economical in first cost and in operation. Fully and interestingly described in a bulletin which can be obtained from Evans Associates, Inc., 225 North Michigan Ave., Chicago, Ill.

Compressor not needed here

That New Jenkins Valve

Industrial Cable:

This new publication of the General Electric Company, Schenectady, N. Y., describes and lists all standard types of insulated wire and cable used by industrials for transmission, distribution and control, and used on or with electric equipment such as mining machinery, locomotives, arc welders, neon signs, etc. It does not cover the paper insulated types of cable, used principally for transmission of large blocks of power at the higher voltages. Such types are custom-built, and generally require the assistance of experienced engineers on both application and installation. This booklet of 128 pp. is a companion to an 80-page publication on "How to Select Insulated Cable." Copies of either are available on request. either can be obtained by addressing a request to the General Electric Company, Schenectady, N. Y.



The New Super-Settler just announced by International Filter

Advanced Sedimentation Methods and Equipment:

New and original flow handling methods are disclosed in the Super-Settler, which provides every facility for assisting in the rapid separation of solids and liquids, and is a radical departure from present methods of handling sedimentation problems in the water and industrial waste treatment fields.

The design is based on the accurate control of the various flows and accelerated handling of the liquid. Maximum utilization of the tank volume is obtained by automatic control over every portion of the entire tank. Settling area can be increased to any desired capacity without changing the length of flow of the material.

The Super-Settler requires approximately one-third the space required by present day settling basins equipped with sludge removal mechanisms. This is made possible by positive control of the various factors which affect sedimentation: flow control of both sludge and liquid, shallow settling depths, rapid evacuation of the material after separation has taken place, velocity of flow, short circuiting, etc. Another exclusive feature of particular advantage is that, the entire sludge removal mechanism may be lifted out and later put back into the tank without stopping the flow through the apparatus.

The Super-Settler is designed to handle any sedimentation problem in the water or industrial waste treatment field, either separate or in combination with the Supermix. Sludge collecting and moving mechanism is extremely simple, and positive in operation.

Appreciable savings on installation and operating costs are possible with this equipment, it is claimed. Complete descriptive matter and drawings are contained in a bulletin issued by the International Filter Co., Chicago, Illinois, which will be mailed upon request.

Blowers:

Standard and heavy duty types of blowers are described in a new bulletin issued by Roots-Connersville Blowers Corp., Connersville, Ind. 8 pp.; lots of good information.

INTERNATIONAL

INTERNATIONAL TRUCKS

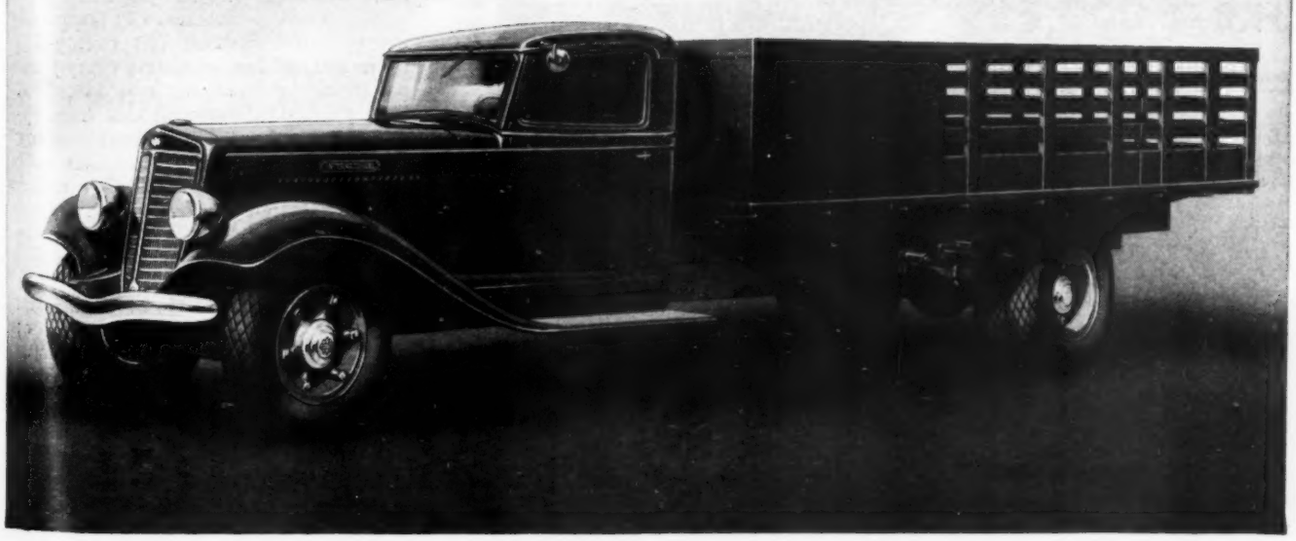
ARE ALL TRUCK

In every inch of Design

In every ounce of Construction

TRUCK quality must be of a different stamp than PASSENGER-CAR quality. Truck users want rugged stamina, for rigorous service! That is why you have lately seen in the truck advertising of some manufacturers so much talk of "all truck." They are aiming to satisfy the demand. But they are only now claiming what International Trucks have *delivered* for many years—EXTRA capacity for taking punishment and giving value. For more than twenty years the International Truck builders have built *only trucks*. No automobiles—no tempting opportunity to compromise. The new streamlined Internationals, with all their beauty of line, give you International ALL-TRUCK QUALITY. Sizes from ½-ton up, chassis f. o. b. prices from $390 up, at all International branches and dealers.

International Harvester Company of America, Inc.
606 S. Michigan Ave., Chicago, Ill.



When you need catalogs—consult the *classified* READERS' SERVICE DEPT., pages 55-57.

What's New in Equipment

36-Hour Floor Repairs:

A new resurfacer has been announced by Stonhard, by which, it is said, floors can be completely resurfaced and made ready for truck traffic in 36 hours. Can be applied with a trowel, and is waterproof. Extensive preparation is said to be unnecessary. Stonhard Co., Philadelphia, Pa., will send data.

Concrete Curing Machine:

A machine designed especially for the curing of concrete, so arranged that it applies a film of asphalt emulsion or cut back, the full width of the slab including the vertical edges, in one time over, has been announced by the Tarrant Manufacturing Company of Saratoga Springs, N. Y. Mounted on roller bearing wheels and equipped with balloon tires, this curing machine is drawn rapidly along the pavement by one man and will completely seal a day's pouring of a large paver in from one to two hours.

Air pressure is used in spraying and the supply of air is automatically regulated. The sprayers are self loading from the shipping drum. The spray bar is instantly adjustable for heighth without the use of tools. All spraying and air lines, including the spray bar, are arranged to be dismantled and assembled by hand.

In use, this sprayer diffuses the material into minute particles mechanically without "misting," eliminating the annoyance of blowing of the bitumen on to passing vehicles or adjoining slabs. An even uniform coating is secured without objectionable streaking and the vertical edges of the slab are also effectively sealed. Over one hundred miles of concrete slabs were cured with these machines in New York State this year and contractors using this method have reported costs substantially lower than methods previously used.

The Tarrant Concrete Curing Machine in Operation.

This new Linn Tractor is especially designed for snow plowing service.

A 12 MPH LINN For Snow Removal

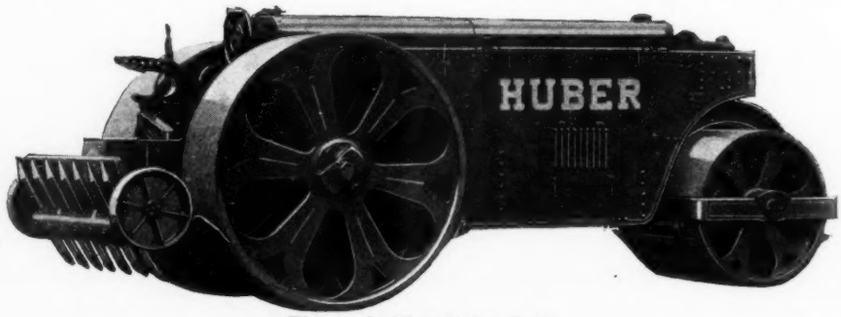
The Linn Manufacturing Corporation, Morris, N. Y., brings out a new high speed, heavy duty model of their truck tractor, the Model 6H-33, for snow plowing service. It was designed to fill the need for a unit capable of plowing deep snow at a high rate of speed, and provide the advantage of high speed for return trips.

The top speed is 12 mph. Tests have proved that it will plow two feet of snow at this high rate of speed, and four feet of snow in fourth speed at 8 mph. It has a maximum drawbar of 45,587 lbs. and a torque of 610 ft. lbs. The motor is a Hercules 6-cylinder Model HXE which develops 174 h.p. Bore is 5¾ inches and strokes 6 inches.

The Model 6H-33 is equipped with closed cab, pneumatic tired wheels or sled steerage, electric lights and starter, high speed reverse (5 speeds each way) and platform body with sides, suitable for mounting snow plow and carrying ballast.

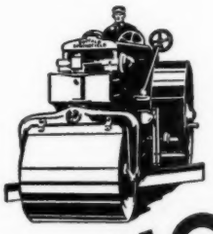
A New Huber Roller:

The Huber Manufacturing Company, Marion, Ohio, has just announced a new 6-cylinder, 3-speed, hydraulically-controlled road roller. The engine develops 59 h.p. at 1200 r.p.m. The new dual steering control provides hydraulic power steer that can be changed instantly to hand steer so desirable in working in tight quarters.

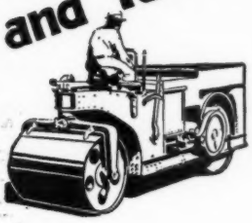


This is the New Huber Roller

Other Huber Road Roller features include (1) a dry removable cylinder sleeve, making cylinder replacement exact, easy and economical; (2) precision engine bearings make it unnecessary to remove engine from chassis to replace bearings; (3) self-adjusting forward and reverse clutches; (4) low pressure hydraulic system; (5) twenty-five roller and ball bearings carry every journal including front and rear axles and king pin; (6) differential lock from operator's platform (7) through going rear axle with direct drive on each roll; (8) low pivot front roll arch makes rolling a straight line over rough ground an easy matter; (9) roller turns on ordinary width road by backing but once; (10) solid hub, web type rolls; (11) more than three quarters of engine and transmission weight below center of rear axle; (12) with 20-inch rear rolls, the Huber is only six feet wide; (13) three speeds in both directions ranging from approximately ¾ to 6 m.p.h.; (14) instantaneous forward or reverse without shifting gears.



BUFFALO-SPRINGFIELD
Three Wheel and Tandem

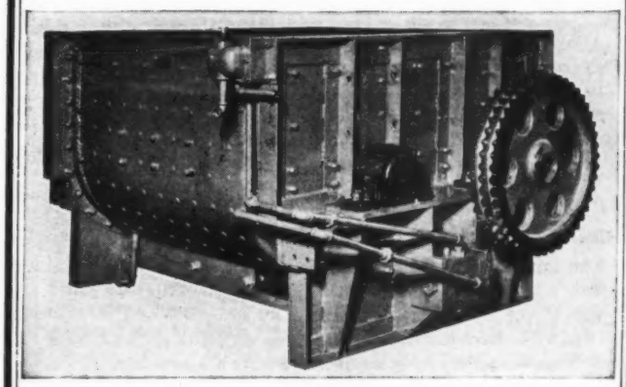


Buffalo-Springfield's complete range of models in both three-wheel and tandem rollers permits the purchaser to select the proper machines for his work.

Full details will be furnished on request.

THE BUFFALO-SPRINGFIELD ROLLER CO.
SPRINGFIELD, OHIO

STEAM JACKETED
STEAM OPERATED ASPHALT MIXERS
For Bituminous Mixtures of All Kinds



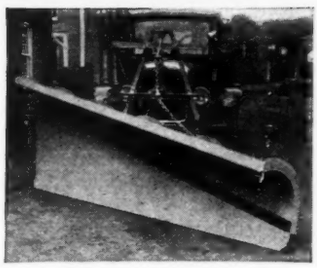
COMPACT DESIGN
WELDED STEEL CONSTRUCTION
ANTI FRICTION BEARINGS
ADJUSTABLE & REMOVABLE BLADE TIPS

Send for Bulletin P-234

HETHERINGTON & BERNER, Inc.
INDIANAPOLIS, IND.

Builders Of Asphalt Paving Machinery For 30 Years

Good Roads



Catalog No. 53 Describes
A SUITABLE PLOW FOR EVERY CONDITION
SEVENTEEN MODELS
Reversible Blade
One-Way High Speed
and V Type Plows

GOOD ROADS MACHINERY CORP.
KENNETT SQUARE, PA.

SNOW PLOWS

JAEGER *Automatic* PUMPS

- Prime Faster
- Pump More Water,
- Pump More Hours

2", 3", 4", 6", 8" sizes. Capacities 10,000 to 125,000 g.p.h.

THE JAEGER MACHINE CO.
400 Dublin Ave.
Columbus, Ohio

8" 125,000 G.P.H.

CONCRETE VIBRATORS Air operated vibrators for all classes of concrete construction including Bridge deck slabs, Dams and Locks, Highway pavement and Concrete products.

WRITE FOR CIRCULARS AND ENGINEERING DATA

MUNSELL CONCRETE VIBRATORS
TEANECK NEW JERSEY

News and Equipment for the Busy Engineer

Personal Item:

Allan Beach, advertising manager of Littleford Bros., Cincinnati, O., manufacturers of road maintenance equipment, for a second time has been elected Secretary-Treasurer of the National Industrial Advertising Association.

American Water Works Assn.:

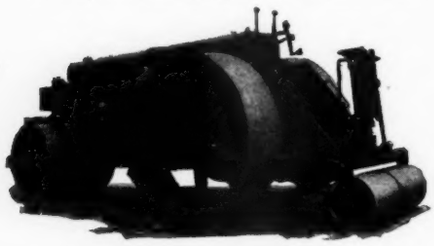
The annual convention of this Association will be held in Cincinnati, Ohio, at the Hotel Netherland Plaza, May 6 to 10, 1934. Beekman C. Little, 29 West 39th St., New York, N. Y., is secretary.

Snow Plows:

An excellent and complete booklet on snow plows, 34 pages, well illustrated, and valuable to the man who has to keep roads and streets clear and open to traffic, has been issued by Good Roads Machinery Corp., Kennett Square, Pa.

Hercules Ironer Roll:

The Hercules Company of Marion, Ohio, announce the Hercules Ironer Roll, an attachment for Hercules three-wheel rollers. This Ironer Roll is an auxiliary roll of small diameter, mounted in place of and interchangeable with the scarifier. It is hydraulically operated, roller bearing mounted and has great flexibility in its operation, having a range from minus 6 inches to 6½ inches above grade, and hydraulic pressure range from zero to 300 pounds.



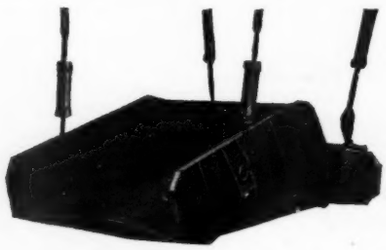
The New Hercules Ironer Roll

In operation, a weight corresponding to more than 50% of the total weight of the entire roller may be exerted on this auxiliary roll, and as the small diameter of the roll provides a shorter arc of contact with the material being rolled, better compaction is obtained, high spots are eliminated and uniformly level surface obtained.

By placing this auxiliary roll at the rear of the roller, a perfect plane is obtained about 17 ft. in length. This long plane surface successfully eliminates short waves in the road surface. A smooth level surface, free from wheel marks is obtained. Less rolling time is required, and the necessity for cross rolling is eliminated.

An Electric Vibrating Feeder:

One of the interesting exhibits at the New England Water Works Convention was an electric vibrating feeder for feeding accurately any dry chemicals for water and sewage treatment. The vibrations were so small that it was almost impossible to detect them, but the feeding was sure and accurate. This equipment, which



The Vibrating Chemical Feeder

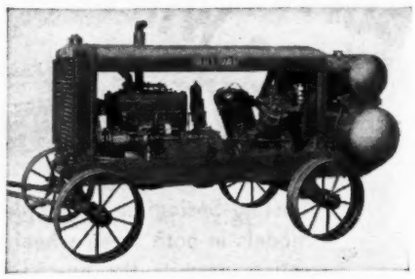
was one of the collection operating under Jeff Corydon's supervision, is made by the Jeffrey Mfg. Co., Columbus, O. One of the neatest little things we ever saw. Folder sent on request. The illustration herewith doesn't do this job justice.

Above, the Wood closed-back shovel which is described more fully at the right.

At the left, the generator-colder-pipe thawer put out by Hobart Bros. Co., Troy, O. This outfit is especially suited to thawing frozen water pipes.

New Portable Compressor:

The Sullivan Machinery Company announces its new Type WK60 Portable Air Compressor. This new compressor is a two-stage design of the angle or "V" type with the air end cooled. This design reduces fuel consumption which is also decreased by a new Wafer valve of exceedingly large port area and very low lift. The design of air ports and air piping provides minimum resistance to air flow. The base is welded structural steel. The main bearings are ball bearings. The number and weight of all reciprocating parts are reduced to a minimum.



Sullivan WK60 Compressor

Type WK60 Portable Air Compressor is now available in the four sizes in greatest demand. All of them may be obtained in any kind of mounting—2 or 4 wheel—steel tires or either kind of rubber tires—or mounted on a truck.

A 1935 Model Shovel:

A closed back shovel has been introduced, which is said to combine the good features of the welded strap, the hollow back, and the solid shank shovels, and overcomes the disadvantages of each. It has a smooth blade, both front and back, and a resilient shank, which is heat treated. It has the "lift" or "bend" of a plain back shovel and the lightness of a hollow back. Handles are straight and easily replaced. The manufacturers say they believe it to be stronger in the shank than any shovel now on the market. It is described in a 8 page booklet which will be sent on request to Wood Shovel & Tool Corp., Piqua, Ohio.

Super-Germite:

In the article published in the September number of PUBLIC WORKS headed: "Two Years' Experience With the Phoenix Activated Plant," the author, Percy E. Mauzey, stated "The screened material is sprayed with a strong solution of Germite and buried—Germite is used for daily spraying the pump room and screen house."

The correct name for the product is "Super-Germite" and it is a product of the Standard Oil Co. of California. The manufacturers say this product has a phenol coefficient of 6, which means that it is six times as strong as pure phenol in germ-killing power. If you have a germ-killing, disinfecting or deodorizing problem, write the Standard Oil Co. of California, San Francisco, Calif., for information regarding Super-Germite.

pages, table, illustrations and usable data.

412. Cliff-Char, a Superior Activated Carbon, for Water Purification. Exceptionally high in phenol adsorption, deodorizing power, taste adsorption, clarifying power. Full information will be sent by Chemical Dept., The Cleveland-Cliffs Iron Co., Union Trust Building, Cleveland, Ohio.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Screens, Sewage

417. The simple, automatic Loughlin self-cleaning traveling screen is fully described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link-Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

419. An illustrated booklet showing installations, and complete details regarding the 19 exclusive improvements which are featured in Shevlin Fine Disc Screens will be sent promptly by the Shevlin Engineering Co., Inc., 227 Fulton St., New York, N. Y.

420. A useful new bulletin for all those interested in sewage disposal, describing some of their proven equipment such as self-cleaning bar screens, grit conveyors, sludge collectors and shredders, has just been issued by the Jeffrey Mfg. Co., Columbus, Ohio. Includes diagrams and many illustrations.

Screens

424. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

426. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Conditioning

382. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

Sludge Incineration

"Incineration Ends the Sewage Disposal Problem" is a new booklet describing the C-E Raymond guaranteed odorless and efficient method of sewage sludge drying and incineration. Just issued by Combustion Engineering Co., 200 Madison Ave., New York, N. Y.

Treatment

429. A new series of bulletins describing their full line of sewage treatment equipment—Fine Screens, Schofield Bar Screens, Vacuum Filters for Sewage Sludge, Decarie Screenings Incinerators, Schofield Bar and Fine Screens, Vacuum Filters for Sewage Filtration and Pneumatic Ejectors for Sewage Screenings—are ready for distribution on request to Municipal Sanitary Service Corp., Room 2703, 155 East 44th St., New York, N. Y.

430. Separate bulletins showing their many lines of sewage treatment equipment will be sent promptly by The Pacific Flush Tank Co., Chicago and New York. The latest is No. 110 describing tray clarifiers.

431. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters, Inc., 33 West 42nd St., New York, N. Y.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., and Philadelphia.

Road and Street Maintenance

Asphalt Heaters

8. Full information concerning their tar and asphalt kettles, surface heaters, oil burners and other road maintenance equipment will be sent promptly on request by Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

200. For general construction and maintenance, the Original Improved "Hotstuf" Asphalt Heater, an economical oil burning heater. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Bituminous Materials

225. A comprehensive manual on the "Use of Emulsions for Street and Highway Construction and Maintenance," discussing types, uses, relative costs, construction details, etc., will be sent promptly on request by Headley Ashphalt Division, Sinclair Refining Co., P. O. Box 73, Marcus Hook, Penna.

226. "Asphalt Surfacing Materials for Low-Cost Roads" is a handy, 28-page booklet illustrating the many types of road surfaces which may be constructed with Texaco asphalt materials. Well illustrated and contains tables of amounts of stone, sand and asphalt required. Sent promptly by the Texas Company, 135 East 42nd St., New York, N. Y.

227. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

228. A new booklet has just been issued by The Barrett Co., 40 Rector St., New York, describing and illustrating the uses of each grade of Tarvia and Tarvialithic. 32 excellent illustrations.

229. A new series of concise and authoritative manuals of construction covering the latest developments in road-mix and surface treatment types as well as the standard asphalt pavements. These contain the best that has been developed by study, research and practical application in all types. Manual 1—Road-Mix Types is now ready for distribution. The Asphalt Institute, 801 Second Ave., New York, N. Y.

229A. Surface Treatment Types, Asphalt Road Construction Manual No. 2. Full details on surface treatments. 14 chapters, 128 pages. The second of those tremendously valuable and handy little manuals put out by the Asphalt Institute, 801 Second Avenue, N. Y. Sent on request.

Snow Removal

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

359. Galion Iron Works and Mfg. Co., Galion, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

STREET, SEWER AND WATER CASTINGS

Made of wear-resisting chilled iron in various styles, sizes and weights

MANHOLE COVERS, WATER METER COVERS, ADJUSTABLE CURB INLETS, GUTTER CROSSING PLATES, VALVE AND LAMPHOLE COVERS

Write for Catalog and Prices

SOUTH BEND FOUNDRY CO.

All Kinds of Gray Iron Castings

SOUTH BEND, IND.

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For the Engineer's Library

The editors will be glad to assist readers in getting copies of publications mentioned here.

Hydraulics of Flood Movements in Rivers:

A survey of the hydraulic theory of flood movements in rivers. Designed for engineers who have had technical training in hydraulics. Comprises a survey of the known hydraulic theory of flood waves, together with original contributions to this theory. In seven chapters: Review of laws governing steady flow in flood channels; uniformly progressive flow; dynamic propagation of stable wave forms; general laws of unsteady flow in a channel; use of hydraulic models; routing flood waves in channels; routing flood waves in rivers. By Harold A. Thomas, assisted by CWA workers. Carnegie Institute of Technology, Pittsburgh. 70 pages. No price given; probably free on request.

Resisting Corrosion from Sewage:

An 8-page mimeographed booklet discussing the resistance of "Ni-Resist" a nickel alloy to corrosion from sewage. Composition and properties; results of corrosion tests; discussion of results; use in grit chambers and bar screens; coarse screens; fine screens; sedimentation units; activated sludge; and other places in the sewage plant. Sent on request to Ralph E. Case, Research Department, International Nickel Co., 67 Broadway, N. Y. Information helping to solve corrosion problems also available on request.

53 Don'ts:

In addition to a list of 53 things you'd better not do with dynamite, there is some excellent information, abetted by simple sketches, on proper uses of this explosive. Priming, charging, tamping and firing are covered briefly but clearly; storing, transporting and thawing are also discussed. Free on request to Institute of Makers of Explosives, 103 Park Ave., N. Y., or the Editor.

Concrete Bridge Details:

A critical discussion of concrete bridge details based on recent extensive field observations is contained in a 48-page illustrated booklet, "Concrete Bridge Details," published by the Portland Cement Association, 33 West Grand Avenue, Chicago, Ill.; copies will be supplied upon request. This booklet, which has reviewed before publication by several leading bridge engineers, presents observations with a spirit of openmindedness and offers constructive suggestions for improved details.

Among the subjects discussed are abutment movements; wingwalls; bridge seats; bearings; expansion joints; prevention of seepage; wearing surfaces; hand railings; construction of approach slabs; and creep in skew bridges. For the first time in concrete literature, proper emphasis is placed on the correct treatment of details.

A Rotogravure Tabloid:

Republic Steel Corp., Massillon, O., has issued a rotogravure tabloid containing 12 pages of illustrations of exhibits at the Century of Progress Exposition, in all of which Republic products are used or displayed.

The Hardest Material:

Norbide—the hardest material ever produced by man for commercial use. This is the trade name for Norton boron carbide, which does jobs previously possible only with diamond dust. It is the hardest material, so far as resisting abrasion, except diamond. Its characteristics, methods of manufacture and uses are described in a booklet issued by the Norton Co., Worcester, Mass. Sent on request.

Concrete Curing:

The bituminous curing of concrete pavements is well covered in this excellent booklet. It is principally a compilation of the data obtained from an investigation of bituminous curing at the Civil Engineering Laboratories of Columbia University, N. Y. There is also information regarding the Hunt process and specifications for curing are given. The booklet will be sent on request to the Johnson-March Corp., 52 Vanderbilt Ave., N. Y.

Manual of Concrete Curing:

The curing of concrete, with especial reference to the use of calcium chloride, is thoroughly treated in a 1934 booklet issued by the Columbia Alkali Corp., Barberton, O. Fifty-five pages of technical data, information, tables, etc.; in the rear, about 20 pages of ruled paper, suitable for an engineer's notebook. Sent on request—and well worth the trouble of making a request.

Modern Water Chlorination:

The Chlorine Institute, New York City, N. Y., has issued a 16-page booklet on this subject, a reprint of a paper by L. H. Enslow. Subject heads are: Combating taste troubles, ammoniation, activated carbon and prechlorination. Sent on request to the Institute.

Public Health Service Publications:

January-June, 1934

The publications listed below, except those marked with an asterisk, are available for free distribution and, as long as the supply lasts, can be obtained by addressing the Surgeon General, United States Public Health Service, Washington, D. C.

1612. Gas hazards in sewers and sewage-treatment plants. By R. R. Sayers. February 2, 1934. 11 pages.
1613. City health officers, 1933. Directory of those in cities of 10,000 or more population. February 2, 1934. 17 pages.

Supplement to the Public Health Reports

110. Court decisions on public health. Review of decisions published in the Public Health Reports during 1930-32. Prepared by William Fowler. 1934. 17 pages.

A Brief Course in College Algebra:

A widely-used book, which has just been revised, and which is especially suited for refreshing the engineer's acquaintance with this subject, and also for home study. By Walter B. Ford. Price is about $2.25.

Differential Geometry:

A new book which covers the fundamentals and modern theorems of the geometry of curves and surfaces. The general text is preceded by a review of solid analytic geometry. By W. C. Graustein. The price is about $4.

Water Treatment News:

A bi-monthly publication, *H-O-H News*, devoted to the presentation of information on water scale and corrosion control and proportioning, is being issued by D. W. Haering & Co., 3408 West Monroe St., Chicago, Ill. If you want to get on the mailing list without cost, write to the above company.

Wells and Well Screens:

An interesting booklet giving very complete information on well screens and deep well construction in general has been published by Edward E. Johnson, Inc., St. Paul, Minn. 24 pp.; ill.

A Directory of Organizations in the Field of Public Administration lists and describes 500 national organizations of the following types: Organizations of public officials and public employees; trade, commercial, and professional associations interested in problems of public administration; citizen groups interested in the improvement of government and public administration. The book enables one to differentiate between organizations with similar names and purposes; learn the specific interests of each organization, the type of questions they are prepared to answer and the services they render; find names and prices of periodicals issued by these organizations; discover sources of recent information on problems in all phases of public administration. The Directory also lists more than 1400 state, regional, and Canadian associations.

This is the second and enlarged edition of the Directory, which was first compiled in 1932. Prepared by Public Administration Clearing House. 192 pages, heavy paper bound. Public Administration Service, 850 East 58th Street, Chicago, Ill. $1.